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THE NATIONAL ELECTRIC LIGHT CONVENTION.

The programme of the National Electric Light Convention to be held next week in Chicago is an exceptionally good one—provided, of course, that the papers carry out the promise conveyed in their titles. The commercial side of central-station management, for example, is represented by a paper on accounting by Lieutenant Cahoon, who has made a special study of the subject, and by another on rates, by Mr. H. L. Doherty, who also is an authority on the branch which he will treat. On the technical side, the live subjects of series alternating-current lighting, combined lighting and railway plants, exhaust steam heating and automobiles will be considered. In view of the present rapid extension of polyphase currents to central-station work, it is somewhat unfortunate that this subject is not represented beyond a paper describing lines of machinery manufactured by one company. We venture to predict, however, that no small part of the discussion will deal with polyphase central-station work, particularly in view of the great object-lesson which will be afforded to the delegates by the Chicago plant, described in other pages of this issue.

The reports of three of the association committees promise to be of much interest—those on standardization, secondary incandescent lamp standards and municipal ownership. The second mentioned is of especial interest at the present time in view of the bill now before Congress, the passage of which will insure a source of supply of standardized incandescent lamps, and will, besides, fill a great need with respect to the authoritative comparison and calibration of electrical measuring instruments. The association will perform a good office for the entire electrical industry by exerting its great influence—both as a body and through individual members—in assisting the passage of the measure establishing a National Bureau of Standardization. A national bureau such as that proposed is the only means of giving practical value to the work which for years has occupied committees of the National Electric Light Association and American Institute of Electrical Engineers, and which otherwise promises to remain indefinitely without practical result.

DISCOLORATION OF OPEN WIRING.

An interesting article by Mr. A. A. Campbell Swinton is reprinted in another page from the London *Electrician*, in which a description is given of some open wiring fastened to the ceiling of a room and supplied from direct-current mains at a pressure of about 200 volts. One of the wires has become much darkened by dust, as also the ceiling immediately over it. The other was but slightly darkened. Both wires, of course, carried the same strength of current, and had the blackening been due to convection current in the air due to heat liberated in the wires, they should have blackened equally. Mr. Swinton shows that the cleaner of the two wires was much nearer to the earth's potential than the other, and that consequently the darker wire was able to attract dust particles to itself by a slow process of feeble electrostatic attraction.

The explanation appears to be satisfactory. The electrostatic effects due to a pressure of only 110 volts is readily appreciable upon an ordinary gold-leaf electroscope, and in connection with 220-volt, 500-volt, or series arc-light circuits, the electrostatic effects increase rapidly. It has been proposed at different times to cleanse the air supplied to dwelling rooms of dust particles by subjecting the incom-

ing stream to a powerful electrostatic stress. The plan does not seem likely to thrive, because the simpler alternative of drawing the intake through a sieve of cotton wool, answers the purpose probably as well, if not better; unless the electrified air has also to be ozonized.

It is a very common observation to find ceiling wires in open wiring selectively blackened. Mr. Swinton seems to think that the negative side of a circuit is the one which is most likely to fall away from grace and insulation, or approach more nearly to the potential of the earth, thereby blackening the positive wires. If the proposition is true that the negative side of a circuit is the one which is most frequently grounded, the fact deserves more widespread recognition. There is nothing impossible in the assertion, in view of the known dissimilarity in the behavior of positively and negatively electrified bodies; but in view of the number of circuits in which it is the positive side that becomes grounded at times, according to our own observation, as well as the fact that in Edison three-wire systems, it is usually the neutral wire which becomes grounded more or less permanently, we doubt the truth of the proposition. It would be both interesting and important to collect data on this subject from the records of central stations, to ascertain whether there is any marked preponderance of negative over positive grounding. It is possible that such a condition might be detected with high-pressure circuits, even if it could not be detected on low-pressure circuits. In the absence of any such evidence we should consider that the dissymmetrical blackening of open wires by dust accumulation is as likely to appear upon the positive as on the negative wire, and depends entirely upon the average potential difference maintained between each wire and the ground. We take it for granted that if two wires be equally well insulated and supplied by a well-insulated source, that they will acquire a dust jacket, and blacken with equal rapidity. Even this proportion, however, is open to dispute, and accurate observations upon the matter are acceptable.

THE COMING SOLAR ECLIPSE.

The solar eclipse of May 28 has no special interest to electrical engineers, although many important questions are raised in such observations, which are of interest to every member of the community. Until the source of radiated solar energy is clearly understood, we are not likely to appreciate and comprehend the nature of the solar rona; but, on the other hand, observations of the corona may elucidate the nature and source of solar radiation. The corona may be traced and delineated on any fine day by the astronomical spectroscope, but can only be fully observed when the moon's shadow hides the glory of the sun. At the least, a total solar eclipse is a rare and beautiful event, and, like lightning, rarely strikes twice on the same spot. More than five hundred years passed in London, England, at one time, without any total solar eclipse. This eclipse comes at a favorable season of the year, and over a favorable region for observation in Mexico and the United States. Unfortunately it will only last a little more than one minute, so that Northerners will have to spend many hours journeying to Norfolk, Va., in order to have eighty seconds' worth of shadow. When we reflect that a really fine eclipse may last seven or eight minutes, we feel inclined to carp at the all too sunny eclipsing this year of the Sunny South.

It should be interesting to observe whether the passage of the moon's shadow across a belt of territory has any appreciable effect upon the earth-currents developed in or near that region. It has been asserted that the passage of sun spots over the sun gives rise to disturbances of the magnetic needle and of earth-currents. If such is the case, it might be expected that an eclipse of the sun might make an appreciable local electromagnetic disturbance on the earth's surface.

INVENTORS AND PATENTS.

To one who regularly looks over the weekly budget of electrical patents, numbering 40 or more, it is apparent that sufficient preliminary consideration is not given by many applicants to the state of the art as bearing on their inventions. For example, it is common to see devices patented which, from their complication and probable manufacturing cost, have no chance whatever to compete with those which they would displace. The opinion also appears to linger with some that the more complicated the device, the greater is its intrinsic merit, which may be true with respect to the ingenuity displayed, but the reverse from the commercial standpoint. In fact, one is struck by the great difference in the character of the patents granted to the professional inventor—if that term may be employed—and to those presumably entering the Patent Office for the first time. Simplicity is a distinguished feature of the former, both with respect to organization and to manufacturing considerations; while the latter frequently betray an utter disregard of every practical consideration, though the basic idea may be recognized as possessing undoubted merit.

Under present conditions, it is often neither difficult nor expensive for a would-be patentee to investigate with respect to patents the state of the branch of the art which he would improve. If living in one of the larger cities or in the vicinity, he may be able to obtain access to a file of U. S. patents, and lacking this, he can always procure from a patent solicitor references to patents, copies of which—if not out of print—can be obtained from the Patent Office at a cost of five cents each. With these before him the inventor will not only be able to determine if he has been anticipated in any essential points, but also receive extension of ideas which may result in transforming a crude into a finished invention. Still further assistance is possible through procuring copies of Patent Office proceedings when there is a probability that these will bear on the invention in hand. Such proceedings are furnished at the cost of transcription, and frequently are invaluable through the references contained. If there is a considerable interval between the date of application and issue of a patent, it can usually be taken for granted that more or less material of this kind is on file, in which case it is, according to law, at the disposition of the public. In such researches as are here indicated, the services of a patent solicitor will greatly expedite matters and most probably reduce the final expense. In fact, the object to be kept in view is the rounding out of one's technical information on the subject in hand rather than the making of the usual patent search.

CHICAGO'S AID IN THE ADVANCEMENT OF CENTRAL-STATION ENGINEERING.

Although the largest central stations might be expected to be the most conservative, especially as regards the adoption of new and untried methods and machinery, they are generally forced, by the necessities of their work, to be the most progressive. The rates charged for electric light and power are, as a rule, about the same in the largest cities as they are in small towns and villages. But in the large cities the cost of real estate and the expense of the underground distributing system necessitate much more rigid economy in the generation of current. In the large plant also the items of depreciation and interest on first cost make up a much larger percentage of the total cost of generation than they do in the small plant where attendance, fuel, supplies and repairs run up to a much higher figure per kilowatt-hour than in the large station. On these accounts the extremely expensive machinery of the large station must be purchased with great care as to the matter of its depreciation. As depreciation of electrical machinery depends more on the advance of the art and consequent reduction of the cost of mainte-

nance, attendance and repairs on new types until old machinery must be discarded for new long before it has reached the limit of its life from any considerations of wear and tear, the purchaser of apparatus must take care that it embodies not only the most recent improvements and advances over previous designs, so far as appears to be safe, but is also capable of being modified to meet any probable change in the methods of working. In fact, to be sure of a reasonably long lease of life, a large machine must be in advance of the times, but woe betide it if its advances are in the wrong direction. As economy of operation and depreciation are so much more important in the work of large central stations than in small ones, the former are called upon to make more radical advances than the latter, although any mistake in these advances is a far more expensive and serious matter with the large plant than with the small one. The very nature of the work in large central stations also involves peculiar difficulties not to be found in the small ones, and these difficulties can of course be solved in the former alone. For these reasons many of the advances of central-station engineering in this country have been carried on in a few large stations. Prominent among these are those of the Chicago Edison Company. Either independently or in co-operation with manufacturers, this company has repeatedly tried apparatus or methods of working which have promised to be of benefit in central-station engineering, and has promptly adopted those found advantageous.

Among the developments which can be credited to the Chicago Edison Company is that of double-current working, which has proven so successful on this company's system that its use is about to be greatly extended. While several of the large Edison companies are abandoning their steam-driven stations within the limits of their heaviest distribution, and are centralizing their generating machinery at some outside point with rotary-converter sub-stations in the places of their old generating plants, the Chicago Edison Company believes in the generation of direct current directly from the engine shaft where the load is so congested that several thousand horse-power can be distributed from one station without excessive feeder lengths. In most of the large cities there can generally be found a location in or near the business centre, where disagreeable local conditions make the property undesirable for office buildings or similar purposes, these conditions, such as the neighborhood of railroad tracks or water frontage, being exactly adapted to central-station needs. In such cases there is so little gained in the direction of lower cost of site by removal to unpopulated locations that the direct generation of the current in its distributed form much more than compensates for the slightly increased cost of the land occupied by the station. Such is the case in Chicago. For the supply of current to comparatively sparsely loaded districts, the Chicago Edison Company has—as have many others—adopted the rotary converter. The alternating power is generated in the same stations that carry the heavily congested direct-current loads in the centre of the city, but no alternating-current generators, pure and simple, are used. The alternating currents are simply obtained from collector rings mounted on some of the direct-current machines which are built with a sufficient number of poles to give the desired frequency, these machines being distinguished by the term "double-current." The advantages of this plan are obvious at first sight. But one type of generating machinery need be used in the stations, and all machines work in parallel with each other, the same generators serve as a reserve for the direct-current and for the alternating-current work, and in case the load peaks of the two occur at different times of day, the same dynamos, engines and boilers may be used to carry both. With the low voltages of lighting work and the low frequency needed for rotary-converter work, the double-current generator—even if direct coupled to an engine—is not so greatly different from the usual direct-current machine, and does not appear to be seriously crowded in its field ring, armature or commutator. Independent regulation of the direct or alternating voltage is easily obtained in lighting work with shunt-wound machines as distinguished from railway work with compound-wound machines; double-current units can be run with perfect ease and safety in parallel with the usual direct-current generators.

Outside of the above-mentioned, sparsely-loaded Edison three-wire, direct-current district, the supply of electrical power throughout the length and breadth of Chicago's all-embracing city limits is now—and will continue to be as long as the present plans are carried out—accomplished by means of alternating currents, without transformation to the direct-current form. In the development of this system to a higher notch than anything preceding it, the engineers of the Chicago Edison Company have made good use of their experience gained in work with polyphase apparatus as an auxiliary to the direct-current work, and have instituted several striking novelties. Chief of these is the arrangement described in the article on other pages of this issue, by which 2200-volt, single-phase lighting feeders are distributed and balanced between the terminals and the common centre of three-phase, Y-connected, 3800-volt generators. While it is obvious that no better balance can be obtained with this arrangement than with that used by some other polyphase stations wherein the 2200-volt, single-phase feeders are delta-connected across the three terminals of 2200-volt, three-phase machines, the new arrangement in Chicago has several advantages. One is that the balancing, *i. e.*, the throwing of a feeder from one phase to another, can be done by means of a single-pole switch, one leg of the feeder remaining connected to the common neutral; and another advantage is that three-phase motor feeders and long-distance trunk lines to sub-stations can be carried at the higher pressure of 3800 to 4000 volts without requiring step-up or sub-station step-down transformers. The existence of a pressure of approximately 4000 volts, instead of the usual 2300, on the lines, throws that much extra strain upon the insulation between the primaries and secondaries of the transformers. If there exists anywhere in the network a ground upon phase *A* and a ground upon the secondary of any transformer connected to phases *B* and *C* there will be a difference of potential of 4000 volts between the primary and secondary of that transformer. The danger to life in case of a fault in transformer insulation and the absence of a ground on the secondary supplied by the faulty transformer, is also correspondingly increased. On the other hand, the recent advances in the art of transformer construction have made all 2200-volt transformers of large sizes safe against the higher pressure, and even the small transformers used in house-to-house service are safer with 4000 volts than were those of a few years ago with their rated voltage. For the supply of induction motors, transformers with standard 2200 to 220-volt windings will be used, their primaries Y-connected in order to take the full line pressure of 3800 volts, and their secondaries delta-connected in order to give the motors the standard pressure. While this Y to delta connection has been shown by experience to be disastrous in its unbalancing effects on lighting or mixed lighting and motor loads, there is no danger of unbalancing with motors only, except such as may be caused by the blowing of fuses in one or two of the phases. As this is almost certain to be followed by the blowing of the fuses in the remaining phases, owing to the transfer of the whole load to them, there is not likely to arise any great increase of voltage across the windings of one transformer and consequent increase of iron losses until the transformer burns out, as might be the case were such serious unbalancing to remain on a group of transformers. Altogether, the 3800-volt system is a most ingenious method of connecting up single-phase feeders to three-phase machines, so as to balance and regulate carefully, as well as to give a higher voltage for comparatively long-distance work without step-up transformation.

The Convention of the National Electric Light Association.

Following is the programme of the Chicago Convention of the National Electric Light Association:

TUESDAY, MAY 22.

Meeting of the Executive Committee, at 9 a. m., secretary's office, Auditorium Hotel. Morning session, 10 o'clock, Convention Hall, Auditorium Hotel. Address by President Carnes. Report of the Committee on Photometric Value of Arc Lamps, Henry L. Doherty, chairman. Report of the Committee on Grounded Circuits, Capt. William Brophy, chairman.

Afternoon session at 2 o'clock.—Paper by Harry J. Frith, Watseka, Ill., and F. A. Copeland, La Crosse, Wis., on "Exhaust Steam Heating." Paper by W. L. Abbott, Chicago, Ill., on "Central Station Economies." Report of Committee on Standardization of Electrical Apparatus, Prof. Francis B. Crocker, chairman.

WEDNESDAY, MAY 23.

Morning session at 10 o'clock.—Paper by Lieutenant James Blake Cahoon, Syracuse, N. Y., on "Uniform Accounting." Paper by Henry L. Doherty, St. Paul, Minn., on "Equitable, Uniform and Competitive Rates."

Afternoon session at 2:30 o'clock.—Paper by Prof. William Lispenard Robb, Hartford, Conn., on "Series Inclosed Alternating Arc Lamps." Report of Committee on Standard Candle-Power of Incandescent Lamps, Dr. Louis Bell, chairman. Paper by R. S. Feicht, Pittsburg, Pa., on "Combination Electric Lighting, Power and Railway Work." Executive session.

Evening session at 8 o'clock in Auditorium Hall. Paper by H. G. Reist, Schenectady, N. Y., on "Alternating-Current Generators." (Illustrated with stereopticon.)

THURSDAY, MAY 24.

Morning session at 10 o'clock.—Paper by Elmer A. Sperry, Cleveland, Ohio, on "Automobiles as a Source of Revenue to Central Stations." Report of Committee on Amendments to Freight Classification, James I. Ayer, chairman. Topic for discussion: "Free Wiring." Discussion by Mr. Chas. R. Huntley, of Buffalo, N. Y.; Mr. E. L. Bemiss, of New Orleans, La., and Mr. Dudley Ferrand, of Newark, N. J.

Afternoon session at 2:30 o'clock.—Report of Committee on Legislative Policy, Samuel Insull, chairman. Report of Committee on Theft of Current, James I. Ayer, chairman. Executive session. Reports of secretary and treasurer, Executive Committee, election of officers.

The insignia will be as follows: Officers, red bow; Executive Committee, blue bow; active members, dark green ribbon; associate members, light green ribbon; reception, yellow ribbon; guests, mauve ribbon; honorary members, white ribbon.

The Reception Committee will consist of the following gentlemen: L. A. Ferguson, chairman; B. J. Arnold, F. B. Badt, George C. Bailey, Charles T. Boynton, C. E. Brown, F. H. Clark, Norman Collins, C. D. Randall, F. E. Donohue, Edward B. Ellicott, Charles E. Gregory, F. S. Gorton, Arthur Hartwell, H. R. Hixson, Samuel Insull, E. B. Kettle, F. W. Kohler, A. O. Kuehmsted, Willard W. Low, A. D. Lundy, G. A. McKinlock, C. E. Munson, J. B. O'Hara, Julian Roe, Thomas I. Stacey, B. E. Sunny, J. B. Wallace, G. S. Whyte, C. H. Wilmerding, J. R. Wiley, James Wolf.

Electric Lighting in Japan.

The first company in Japan to furnish electricity for lighting purposes was the Tokio Electric Company, which was followed by companies in Kobe, Osaka, Kyoto and Yokohama. The Osaka Electric Company began supplying current for incandescent and arc lights in 1889, at the end of which year the company furnished electricity for 1681 incandescent and 11 arc lights. In 1884 the capital of the company was increased from 400,000 yen ($200,000), the original capitalization, to 800,000 yen ($400,000), and in that year 13,152 incandescent and 82 arc lamps were maintained. Two years later the capital was double, and during that year (1896) the company supplied current for 21,282 incandescent and 71 arc lights.

The paid-up capital of the company is now 1,040,000 yen ($520,000), and on March 1 the company had contracts for supplying 31,364 incandescent and 144 arc lights. A charge of 1.70 yen (85 cents) a month is made for standard lights of 16 candle-power to be used throughout the night, as against, for the same service, 3 yen ($1.50) in Tokio, 2.50 yen ($1.25) in Yokohama, 1.95 yen (97½ cents) in Kobe and 1.20 yen (60 cents) in Kyoto, where water is utilized for power. The last dividends (per year) paid by the companies were as follows: Kyoto, 17 per cent; Osaka, 16 per cent; Kobe, 14 per cent, and Tokio, 8 per cent.

The New York City Independent Telephone Movement.

The Knickerbocker Telephone & Telegraph Company announces that it has commenced the construction of its plant, which will be extended to all the five boroughs of New York City, and that it has placed canvassers on the street who are engaged in soliciting subscribers for telephones at the following rates:

For service to any points within the five boroughs forming New York City the price for unlimited service is, business telephones, $120 per year; residence telephones, $60 per year. For limited service the following is the schedule of rates:

No. of messages sent in one year.	Annual rate.	Additional messages.
700	$60.00	6 cts.
1000	70.00	6 cts.
1250	80.00	5 cts.
1500	90.00	5 cts.
2000	100.00	4 cts.
2500	110.00	4 cts.

Special rates are accorded to extensive users of telephone service in all boroughs and for strictly local service in the Boroughs of Queens and Richmond.

"Green Goods" Telegrams.

An interesting case, involving the use of telegraphic cipher codes, was decided a few days ago by Judge Blair, in Jersey City. Last year indictments were brought against the Western Union Telegraph Company and John B. Bartholf, the Jersey City manager, for aiding and abetting green goods swindlers in carrying on their operations. In requesting the Judge to nolle pros. the indictments, Senator Allan L. McDermott said it was doubtful if the State could secure a conviction on account of the difficulty of procuring evidence. It was impossible for the company or Mr. Bartholf to distinguish between green goods and legitimate business telegrams. For instance, when a despatch like this came: "Mother is dead, will be on to-morrow," Mr. Bartholf had no means of knowing that it referred to the green goods business. The sender's mother might be dead or it might be a legitimate business despatch in cipher. Every precaution had been taken by the company to detect and stop swindling telegrams, but they could not be stopped altogether on account of the difficulty in detecting them. Judge Blair granted the motion to nolle pros. the indictments.

Progress of Automobile Construction.

On April 28, Prof. R. H. Thurston, of Cornell University, gave a lecture at the Waldorf-Astoria, before the Automobile Club of America, entitled "The Trend and Progress of Automobile Construction." As early as 1831, Prof. Thurston said, the automobile had become a fact, and in that year a parliamentary committee reported favorably on the machine. But legislative obstruction and the introduction of the railway hindered its progress, and for a time it slipped out of its sight. It is only in recent years that the automobile has again been brought forward. In 1857 or 1860 he rode in a steam automobile in Boston; it was made by a watchmaker there, and the two drove to Cambridge and across country in a carriage that was easy and comfortable. Among the first to introduce a vehicle running with its own power was John Ericsson. There never has been any doubt in the mind of engineers that automobiles ought to have come in use long ago. Prof. Thurston suggested that several lines of experiment might be profitably followed to get the best results in automobiles. Some working fluid may yet be discovered, he said, that may be superior to steam or to anything in use at present as a working power, especially in the case of small automobiles. A good speed-changing device is a very desirable thing in automobiles, for an increase of elevation of 1 per cent in grade will make considerable difference in the power of automobiles. It is important that this fact be borne in mind.

The Central-Station Situation in the City of Chicago.

THE development of the city of Chicago has been such as to offer peculiar advantages and peculiar difficulties to the introduction of electric lighting and electric power distribution. The greatest growth of the city has been realized during the era since the electric light took the place of gas as the best means of illumination, thus facilitating the introduction of electricity to a much more general use than in the older large cities of the East which, to a great extent, grew up in the gas age, established their habits of illumination during that time, and in consequence were piped rather than wired for illuminating purposes. The peculiar local conditions of Chicago, among them being the prevailing murkiness of its atmosphere, the extreme height of its office buildings and the consequent darkness of its business streets, the activity of its business section after nightfall, the lavish prodigality and strong local patriotism of its citizens and their determination to have the best regardless of cost, have caused a phenomenally large demand for electric current per foot of main in the restricted down-town centre of the city. These are in brief and in part the advantages, which, as mentioned above, have favored the extensive use of electric lighting in the city of Chicago.

On the other hand, outside of the congested district of sky-scraping buildings, the conditions confronting the central-station interests have been peculiarly trying for a metropolitan city. The residential area of Chicago is extremely wide-spread, and the population, although large, is thinly scattered. These conditions have almost entirely prevented the use of low-tension distribution in the residence districts, and necessitated the construction of alternating-current lighting plants of low first cost. Naturally, in a progressive western city, the limits of which include an area of about 250 square miles, with plenty of promoters and financiers alive to the prospective value of a franchise, these scattered plants of mushroom growth were quite numerous. Just as naturally they have failed to prove profitable with their competition, small loads and inefficient apparatus, and have recently all become associated under one management. This management is now confronted with the Arabian Nights' problem—by no means found only in Chicago—of exchanging new lighting systems for old; the new consolidated systems to be a permanent investment, capable of distributing their power over wide districts at low cost, and capable of performing the various services for which central-station outputs have been found adapted without the variety of kinds of current hitherto found necessary for such adaptation. On account of the originality displayed in the solutions of this problem, as well as the existence of almost exactly the same problem in many other places, the suburban work will be discussed below in greater detail than the more special and heavy work of the down-town district, which has, to a large extent, been covered in previous publications.

THE OPERATING COMPANIES AND THEIR ORGANIZATION.

All central-station work in the down-town districts of Chicago, with the exception of the street lighting which is supplied from

FIG. 1.—VIEW OF THE OPERATING ROOM OF THE NO. 1, OR HARRISON STREET STATION, OF THE CHICAGO EDISON COMPANY, LOOKING FROM THE SWITCHBOARD GALLERY.

The rated capacity of the generating machinery in this station is 6400 kilowatts. In the right and left foreground, and distinguished by their large number of poles, are the double-current generators, the alternating output of which is regulated and transformed by the apparatus in the central foreground.

the municipal plant mentioned hereafter, is carried on by the Chicago Edison Company. The city limits of Chicago embrace such a wide area, 14 miles wide by 24 miles long, that what has been termed above as suburban work is in reality entirely within the city limits. All central-station work within the city limits, and outside of that done down-town by the Edison Company, is carried on by the

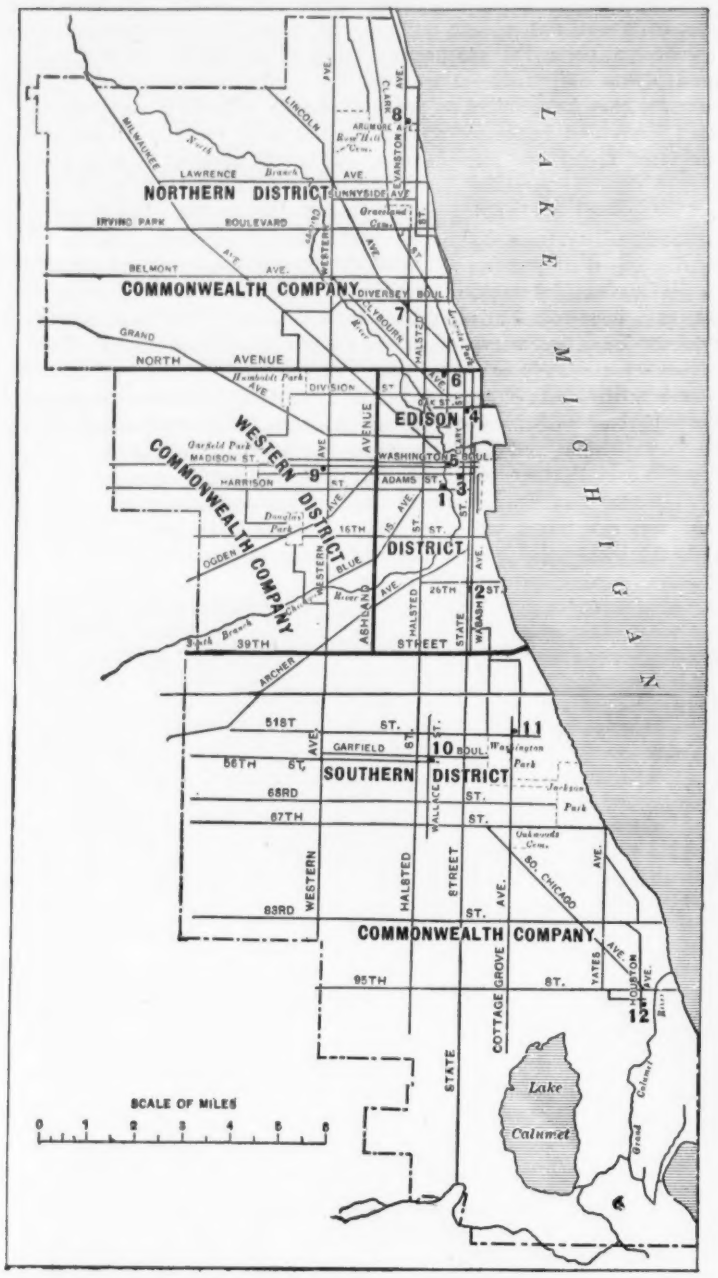


FIG. 2.—MAP OF CHICAGO, SHOWING THE DISTRICTS COVERED BY THE CHICAGO EDISON AND COMMONWEALTH COMPANIES, AS WELL AS THE LOCATION OF THE STATIONS AND SUB-STATIONS OF BOTH.

No. 1—Edison Station No. 1, Harrison and Charles Streets. No. 2—Edison Station No. 2, 2364 Wabash Avenue. No. 3—Storage-battery Sub-station of Edison Company and Offices of Edison and Commonwealth Companies, 139 Adams Street. No. 4—Edison Station No. 4, Newberry Library, Oak and Clark Streets. No. 5—Edison Station No. 5, Market and Washington Streets. No. 6—Edison Rotary Sub-station on North Avenue. No. 7—Commonwealth Station D, Northern District. No. 8—Commonwealth Transformer Sub-station. No. 9—Commonwealth Offices, Western District. No. 10—New Commonwealth Station, Fifty-sixth and Wallace Streets. No. 11—Commonwealth Regulating Sub-station at Englewood. No. 12—Commonwealth Sub-station, South Chicago.

Commonwealth Electric Company. About two years ago the latter company was organized by the management of the Edison Company for the purpose of acquiring and consolidating the properties and franchises of the various independent concerns within the city, and of operating the same in harmony with the Edison interests. The companies thus brought together were the following: The Western Light & Power Company, the Hyde Park Thomson-Houston Light Company, the Englewood Electric Light Company, the Mutual Electric Light Company and the People's Electric Light & Motor Power Company.

The two companies, the Edison and the Commonwealth, are closely associated. The executive officers of both are the same, as follows: President, Samuel Insull; secretary and treasurer, F. S. Gorton; comptroller, W. M. Anthony; general superintendent, L. A. Ferguson.

The Commonwealth Company now owns or controls all plants and franchises within the city limits, outside of those of the Edison Company. The franchise of the Edison Company permits it to distribute underground only, while the Commonwealth Company's rights permit it to distribute underground in certain parts and overhead in other parts throughout the city.

The general offices of both companies are in the newly reconstructed Edison Building, 139 Adams Street, Chicago. For convenience in handling its local work, however, the widely extending parts of the city operated in by the Commonwealth Company have been divided into three districts, as shown on the accompanying map, Fig. 2, and the work in these three districts is directed by three local superintendents, one for the south, another for the west, and a third for the north side district. The local business between the Commonwealth Company and its consumers, including the collections of all accounts receivable, is carried on from the local or district offices. The general direction of the Commonwealth Company's affairs and the disbursements on accounts payable are carried on from the down-town Chicago office. The capitalization and amount of business handled by the two companies, as shown by the last annual report for the fiscal year ending March 31, 1900, are as follows:

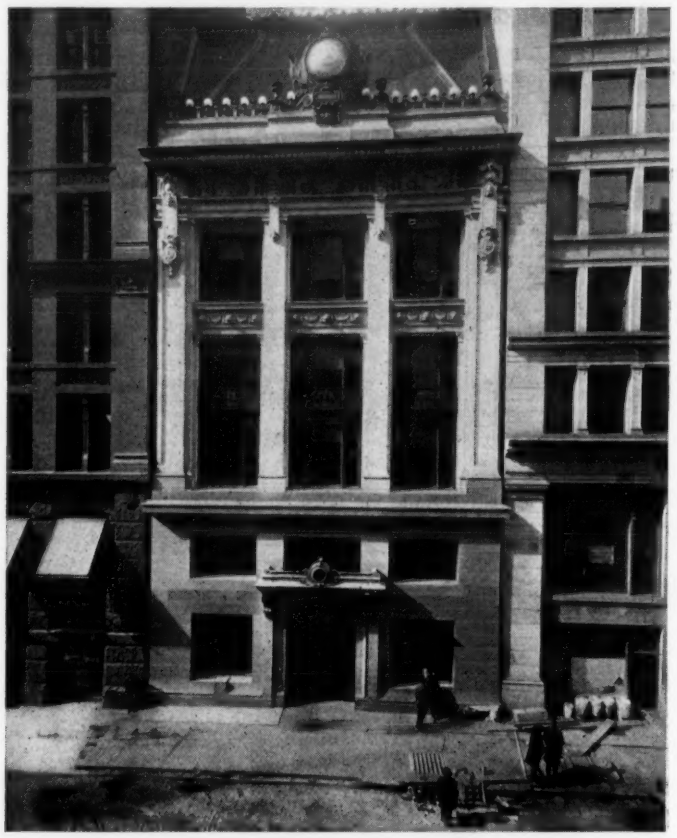


FIG. 3.—FRONT OF THE OFFICE BUILDING OF THE EDISON AND COMMONWEALTH COMPANIES, 139 ADAMS STREET. THE BUILDING CONTAINS THE LARGEST SINGLE EQUIPMENT OF STORAGE BATTERIES IN THE WORLD.

	Edison.	Commonwealth.
Capital stock	$5,971,100	$5,000,000
Bonds	4,808,000	2,500,000
Value of plants, real estate and franchises.	10,817,676	7,643,682
Total load connected in 16-cp equivalents	594,202	178,950
Gross income	2,133,827	517,131
Operating expenses, repairs and renewals	1,321,437	339,169
Net income	$812,390	$177,961
Bond interest	265,243	124,992
Earned on stock	$547,147	$52,969

A BRIEF DESCRIPTION OF SOME OF THE EDISON STATIONS.

As will be noted from the map given above, which shows the lay-out of the city of Chicago, the Edison Company feeds current into its 230-volt network at six stations or sub-stations. A few notes concerning the recent work and additions at these stations may be of interest to attendants at the coming convention of the National Electric Light Association who may wish to visit the stations and see some of the recent work. The largest and finest of these plants is Station No. 1, on the west bank of the Chicago River at Harrison Street. Although this great generating station was laid out eight years ago, its design has proven to be perfectly adapted to the purpose for which it was intended, viz., the generation of low-tension direct current. The modifications which have been made during the last two years have been for the purpose of adapting the apparatus to the interconnection of generating stations by means of high-tension polyphase transmission lines, a system which has been extensively adopted by the Chicago Edison Company, as will be noted below. The No. 1 or Harrison Street station now contains 10 vertical triple-expansion three-crank engines, each driving a three-wire set consisting of two multipolar generators mounted on the ends of the engine shaft. Of the 20 generators, eight have a capacity of 200 kilowatts each and the other twelve 400 kilowatts each, giving a total rated generating capacity of 6400 kilowatts. Of the recent and proposed work at this station the following points are of greatest interest:

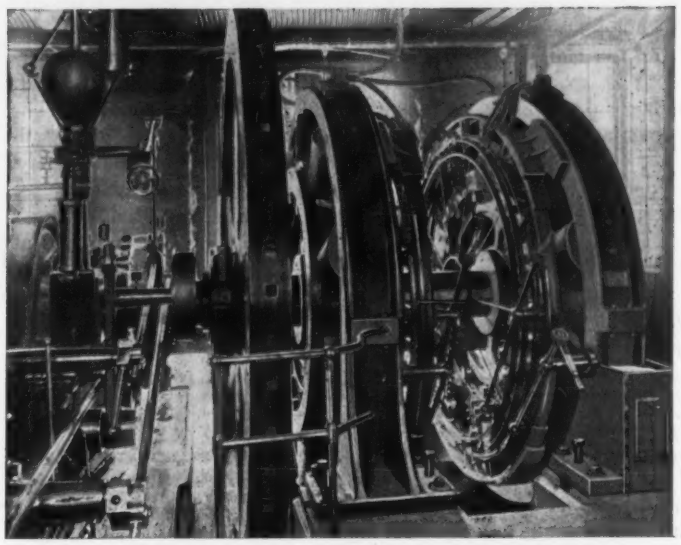


FIG. 4.—AN ODD THREE-WIRE UNIT, CONSISTING OF TWO GENERATORS WITH FACE COMMUTATORS FACING EACH OTHER, MOUNTED BETWEEN THE MAIN AND OUTBOARD BEARING OF A HORIZONTAL ENGINE.

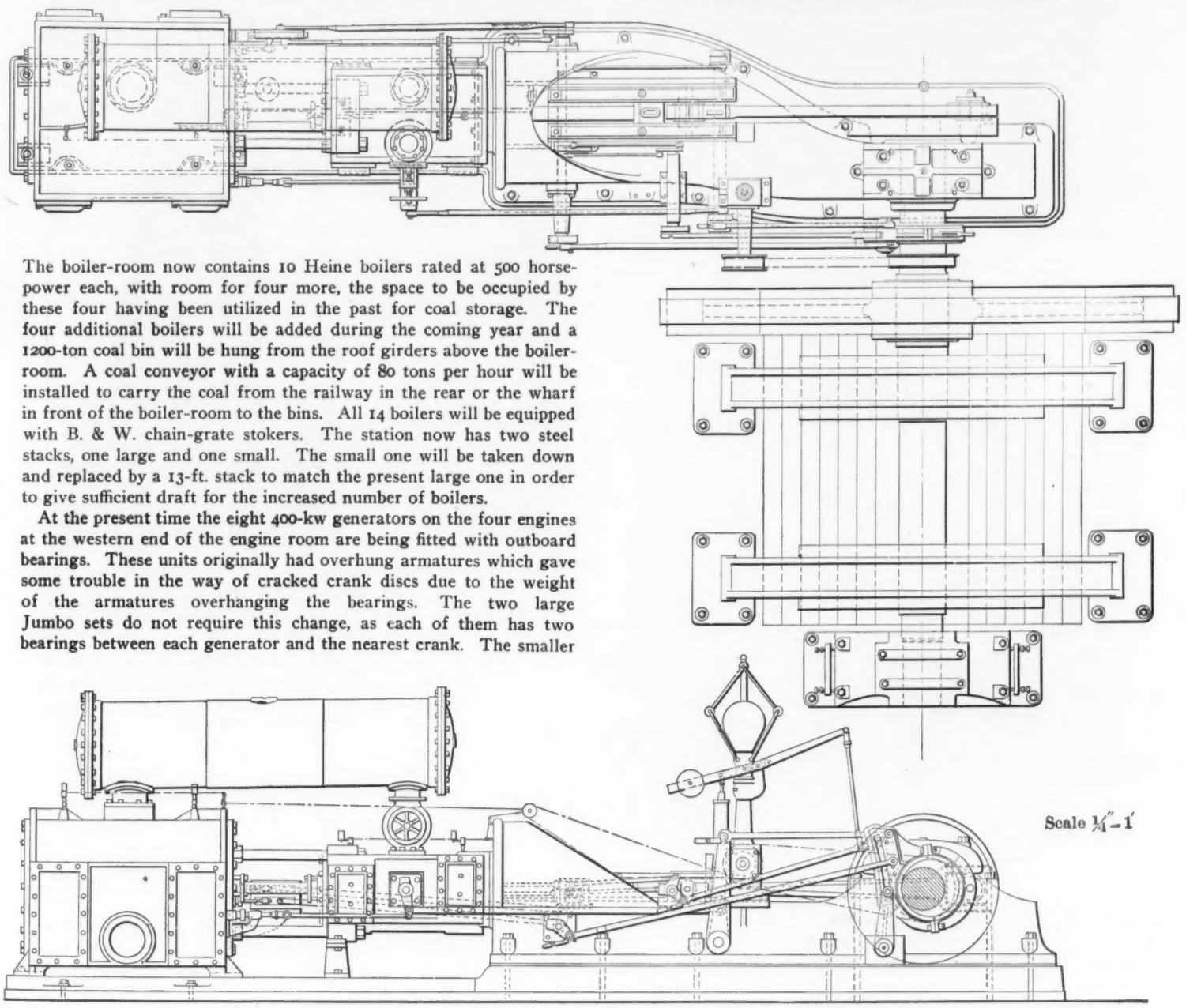


FIG. 5.—PLAN AND ELEVATION OF THE ENGINE AND GENERATORS, ILLUSTRATED IN FIG. 4. THERE ARE FOUR OF THESE IN THE NO. 5 STATION, CORNER WASHINGTON AND MARKET STREETS.

The boiler-room now contains 10 Heine boilers rated at 500 horse-power each, with room for four more, the space to be occupied by these four having been utilized in the past for coal storage. The four additional boilers will be added during the coming year and a 1200-ton coal bin will be hung from the roof girders above the boiler-room. A coal conveyor with a capacity of 80 tons per hour will be installed to carry the coal from the railway in the rear or the wharf in front of the boiler-room to the bins. All 14 boilers will be equipped with B. & W. chain-grate stokers. The station now has two steel stacks, one large and one small. The small one will be taken down and replaced by a 13-ft. stack to match the present large one in order to give sufficient draft for the increased number of boilers.

At the present time the eight 400-kw generators on the four engines at the western end of the engine room are being fitted with outboard bearings. These units originally had overhung armatures which gave some trouble in the way of cracked crank discs due to the weight of the armatures overhanging the bearings. The two large Jumbo sets do not require this change, as each of them has two bearings between each generator and the nearest crank. The smaller engines with 200-kw generators also run all right with the overhung arrangement. There have also been installed in this station within the last four years four double-current generators and alternating-current apparatus, which equipment will be greatly extended in the

near future. A description of this will be given below in the account of the polyphase features of the system.

From the Harrison Street station a large amount of power is carried by a trunk line to the sub-station at 139 Adams Street. This is a storage-battery sub-station and centre of distribution. The building has, during the last year, been reconstructed to give sufficient space for the enlargement of the battery. The original battery, with a capacity of 11,200 amperes for one hour, or 22,400 ampere hours at an eight-hour discharge rate, has been duplicated, giving a capacity of 22,400 amperes for one hour, or 44,800 ampere hours at an eight-hour rate to the two sides of the system. The original battery is in the basement of the building, the new one is on the ground floor level and space has been left on the mezzanine floor for a third battery of the same size. The upper floor are occupied by the offices, draughting room, electrical laboratory, photometer room, etc., of both the Edison and Commonwealth Companies.

The next station in point of interest is No. 5, at the corner of Washington and Market Streets, and also on the Chicago River. This is the property inherited from the Chicago Arc Light & Power Company. Part of the original equipment is still in use, consisting of horizontal tandem-compound engines on the lower floor connected by ropes to a long counter shaft on an upper floor, in turn belted down to arc machines and high-frequency alternators on an intermediate floor. These alternators and arc machines supply the whole of the western district of the Commonwealth Company. With the growth of the demand for low-tension current in the downtown district it became desirable to install three-wire sets, which, on account of the limited space in which they had to be set, took the odd form indicated in the photograph, Fig. 4, and the plan, Fig. 5. The engines are Southwark tandem-compounds with side cranks, each driving direct two 200-kw 150-volt generators of the multipolar smooth-body type with face commutators, the two machines being mounted between the main and outboard bearings of the engine with the commutators of the two facing each other. There has also been

FIG. 6.—ONE OF THE 200-KW DOUBLE-CURRENT UNITS AS SET UP FOR TESTING, SHOWING THE COLLECTOR RINGS WITHIN THE COMMUTATOR.

installed in the same station a 1000-kw 300-volt machine, also direct-driven by a Southwark horizontal tandem-compound engine, this machine supplying current directly to the positive and negative conductors of the three-wire network. In the down-town districts the Edison Company is now changing over about 500 commercial arcs from series circuits to the low-tension constant-potential mains. This will take the load off from some of the engines driving the counter shaft in this station. Two 600-hp horizontal tandem-compound Williams engines now in this service will be fitted with direct-coupled 300-volt 400-kw generators designed to feed the outers of the Edison network.

On the upper floors of the building which contains this station the Chicago Edison Company has complete machine shops, equipped for armature and transformer rewinding, commutator rebuilding, switchboard construction, and general repairing, as well as the shop work involved in the complete equipments of isolated plants which are installed by the construction department of the Chicago Edison Company. By means of these shops the company is enabled to carry out changes and repairs on its systems more promptly than it otherwise could, especially when the manufacturing companies are as heavily overloaded with advance orders as they are at present.

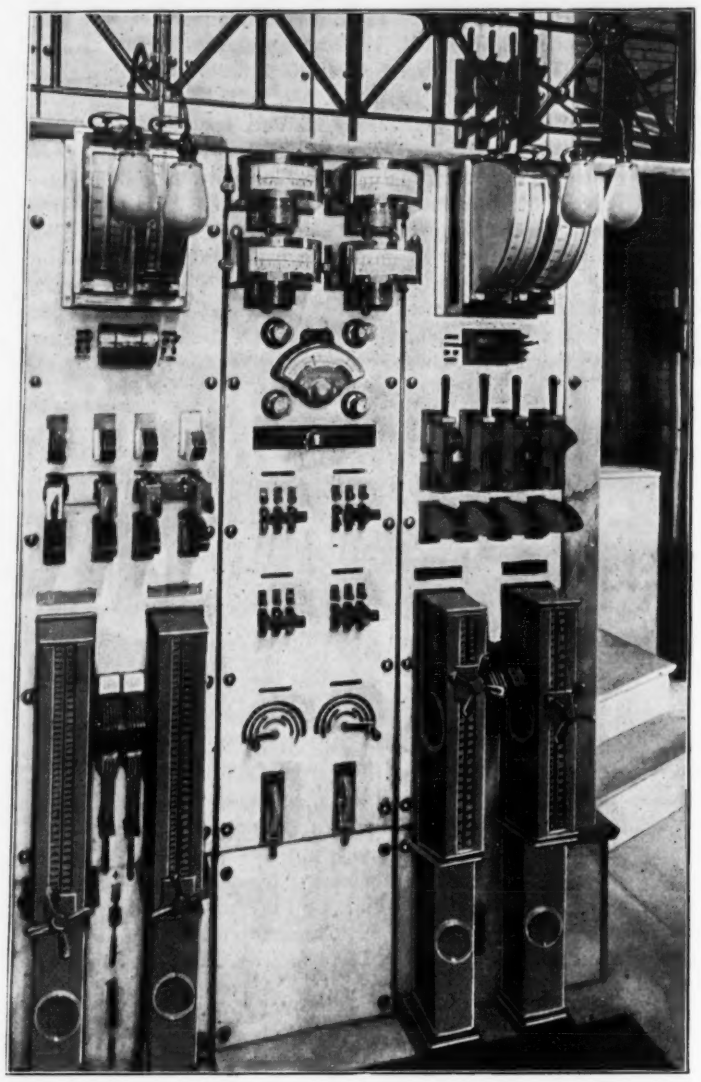


FIG. 7.—THESE THREE SWITCHBOARD PANELS CONTROL BOTH DIRECT AND ALTERNATING CURRENT ENDS OF TWO COMPLETE DOUBLE-CURRENT, THREE-WIRE UNITS, COMPRISING FOUR 200-KW GENERATORS.

THE POLYPHASE INTERCONNECTION SYSTEM BETWEEN THE EDISON STATIONS.

As is well known, the Chicago Edison Company was one of the pioneers in the use of rotary converters and double-current generators for the cross-connection of generating stations in order to enable one plant to help out another as desired. The installation of 25-cycle apparatus on the Chicago Edison system is steadily advancing, and within a year all of the five stations of the company will be working in synchronism with each other on high-tension lines, as well as in parallel with each other on the 230-volt network which is connected through continuously from station to station. Parts of this complete high-tension, interconnecting system are at present installed and in operation. These parts consist of two independent transmission lines, one from Station No. 1 at Harrison Street and the river to Station No. 2 at Wabash Avenue, near Twenty-sixth Street, and the other

from Station No. 5 at Washington and Market Streets to the North Avenue rotary-converter sub-station at the extreme northern edge of the Edison district. These two transmission lines will be placed in parallel with each other by a high-tension trunk line between Stations 1 and 5. The amount of polyphase apparatus in the four stations thus cross-connected will be increased and rotary-converters will be placed in the fifth station, thus putting all five in parallel with each other by the polyphase equipment, as well as through the direct-current network into which they all at present feed in parallel with each other.

The North Avenue sub-station has no steam generating equipment, but all four of the others have boilers, engines and direct-current generators in addition to the polyphase apparatus. The two larger stations, Nos. 1 and 5, both of which are situated on the river, convenient for coal and water, will be continued as generating stations, and the steam equipment of Nos. 2 and 4 will be either taken out or maintained solely as a reserve for a means of helping out the larger stations at times of heavy load. The greater part of the three-phase alternating power will be generated at the No. 1, or Harrison Street station, which is best adapted to generation at lowest cost. No. 5 will either give or take power to or from the three-phase transmission lines, according to the needs of the service.

An unusual feature of high-tension transmission and interchange of power, first worked out on the Chicago Edison system, is the use of double-current generators. In the company's No. 1, or Harrison Street station, there are two three-wire units, the four generators of which are fitted with collector rings to give three-phase, alternating currents, the generators having a sufficient number of poles to give these currents a frequency of 25 cycles. Each of these four generators can deliver 200 kilowatts at 125 volts to the direct-current busbars of the station, and normally they are worked in parallel with the plain direct-current machines. Through their collector rings they can deliver to the alternating-current circuits three-phase currents at about 80 volts pressure, or they can deliver power simultaneously to the direct and alternating-current systems in any proportion, so long as the total output of each machine to both systems remains within the capacity of the machine, or 200 kilowatts.

Fig. 6 shows a view of one of these double-current generators set up temporarily for testing purposes, indicating its 20 poles necessary to give 25 cycles at 150 r. p. m., as well as the arrangement of its collector rings within the annular commutator. Two of these machines are coupled to the two ends of the shaft of a 600-hp Southwark vertical, triple-expansion engine, there being two such engines with four double-current machines in the Harrison Street station. These two engines formerly drove direct-current machines, which were removed to give place to these double-current generators. The advantage of these machines over either direct-current machines or alternators in situations of this kind, is that they are available for either class of service. If the load peak of the station in which they are installed occurs at a different hour of the day from that of the station to which their alternating currents are transmitted, they and the corresponding engines and boiler capacity are available for the peaks of both stations. In any event, they serve as a reserve for both stations and also when running serve as a means of shifting portions of the load from one to the other station at any time.

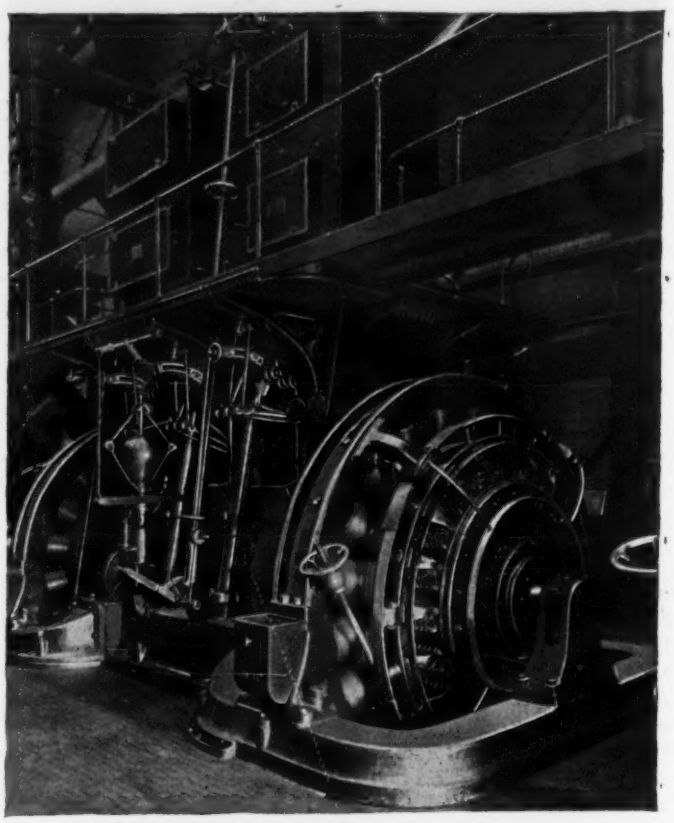


FIG. 9.—ONE OF THE DOUBLE-CURRENT GENERATING SETS COMPLETE.

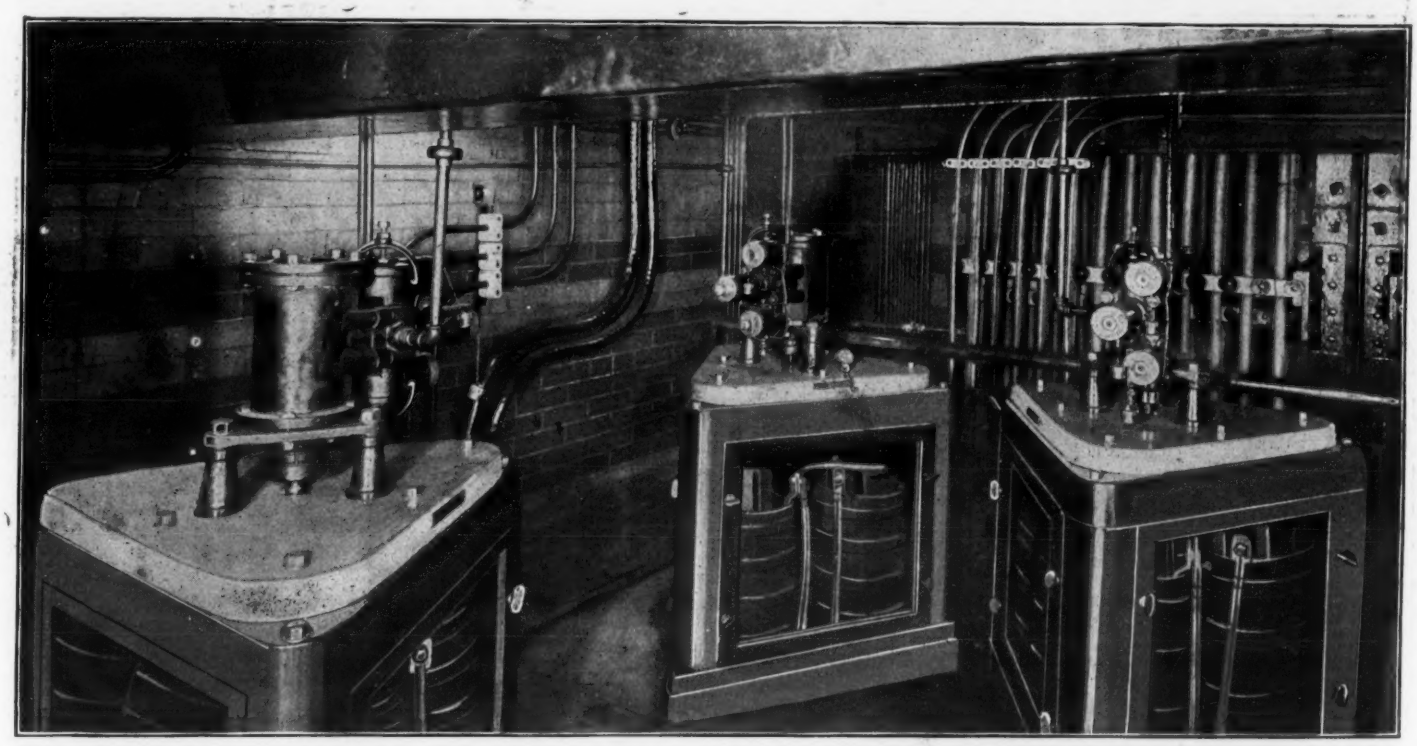


FIG. 8.—THE THREE ELECTRO-PNEUMATIC SWITCHES FOR THE TWO GENERATING UNITS AND THE ROTARY CONVERTER.

Owing to the low pressure at which the alternating currents are

FIG. 10.—ALL STATIONS OF THE EDISON AND COMMONWEALTH COMPANIES ARE EQUIPPED FOR AUTOMOBILE CHARGING. THIS VIEW SHOWS AN ELECTRIC HANSOM "FRESHENING UP" AT THE WABASH AVENEUE ROTARY-CONVERTER STATION.

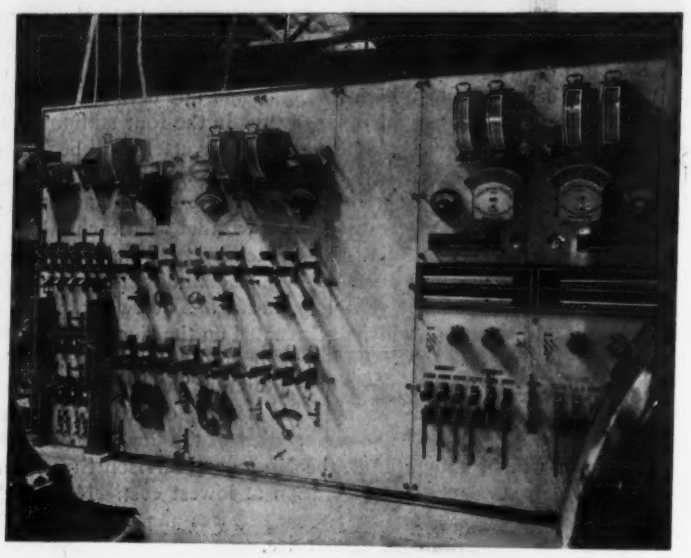


FIG. 12.—A MACHINE AND STORAGE-BATTERY SWITCHBOARD AT THE WABASH AVENUE STATION. AT THIS BOARD THE FIVE ROTARIES SHOWN IN THE ILLUSTRATION BELOW ARE HANDLED, AS WELL AS A LARGE STORAGE BATTERY.

necessarily generated in double-current machines—since they come from the same windings that generate the direct current—step-up transformers must be installed to give the line pressure, which is in this case 4500 volts. For this purpose six 150-kw forced-draft transformers are mounted on a platform in the Harrison Street station, as shown in Fig. 1, three transformers for each pair of generators. As the two generators of one pair are worked in series with each other on the direct-current end they cannot be electrically connected in parallel with each other on the alternating-current end. For this reason they are connected to electrically-independent primaries in the same step-up transformers. In this way they are inductively but not electrically in parallel with each other on the alternating-current end. To give a means of varying the alternating voltage independently of the direct voltage, forced-draft I. R. T. regulators are mounted on the same air-pressure platform which carries the transformers. In order to allow one generator of a three-wire unit to work at a different voltage from the other machine of the same unit, as is necessary when the direct-current load on the station is unbalanced and a higher direct voltage is wanted on one side of the Edison system than on the other, a separate regulator is put in for each generator; otherwise the two generators of one set, if connected in parallel on the alternating end, would force each other to the same voltage. In addition to these four double-current machines, there is one 250-kw rotary-converter in the Harrison Street station, designed to take power from the direct-

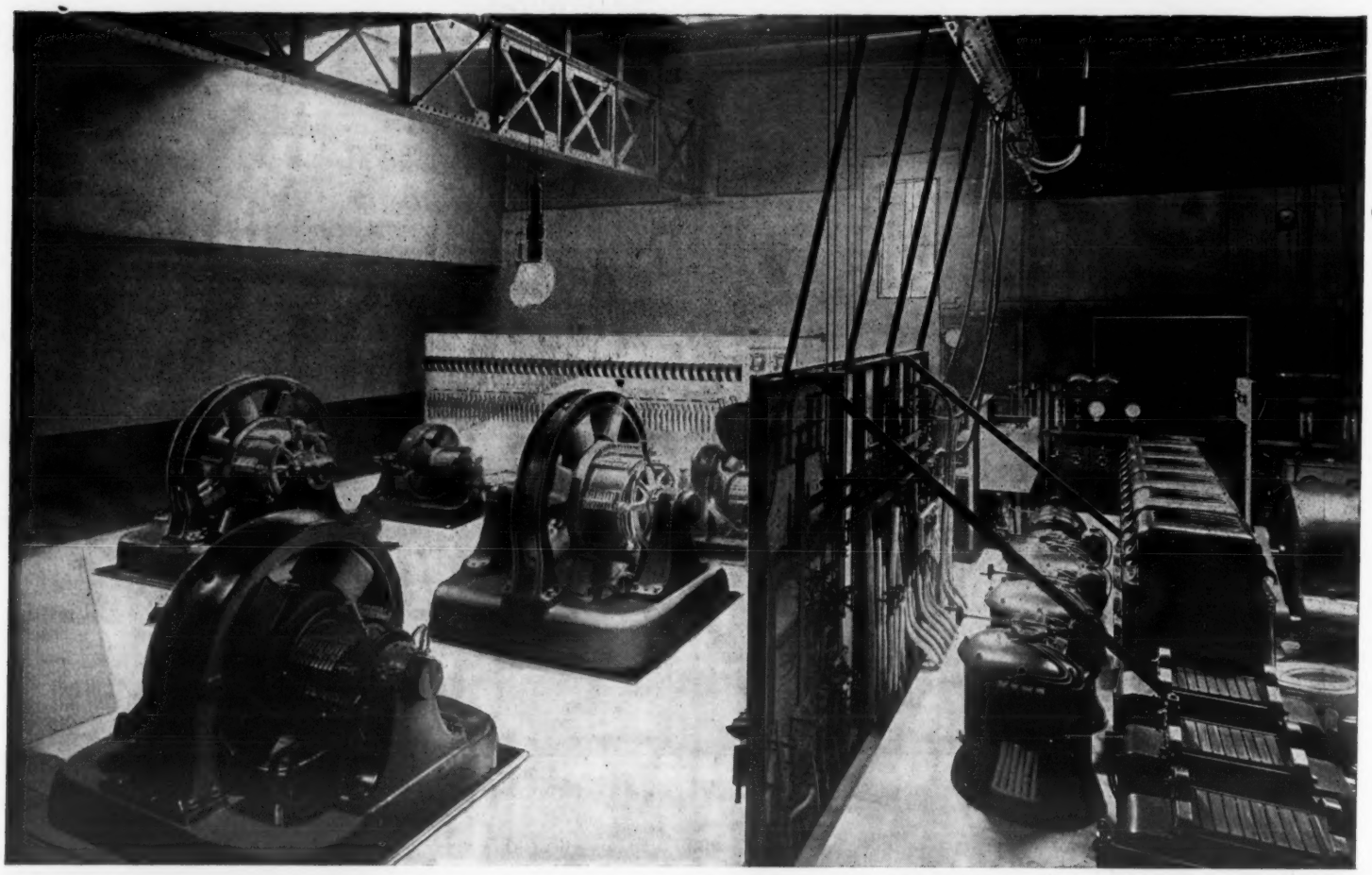


FIG. 11.—AN INTERIOR VIEW OF THE WABASH AVENUE ROTARY-CONVERTER EQUIPMENT. THE ROTARIES CONSIST OF ONE 250-KW, TWO 200-KW, AND TWO 100-KW MACHINES.

current bus-bars and deliver alternating current to the transmission line. This converter works in parallel with the double-current generators, or takes the load when they are not working.

These double-current units have proven so advantageous that the next addition to the Harrison Street station will also be adapted to generate both kinds of current. This addition will be a single 2500-kw generator, wound to give from its commutator full pressure between the positive and negative bus-bars of the three-wire system, or 300 volts. The machine will be a record-breaker in two directions, being

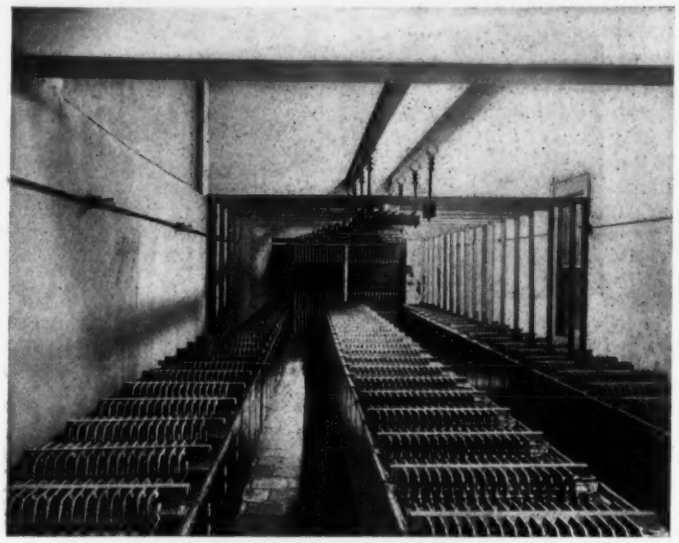


FIG. 13.—VIEW IN POSITIVE BATTERY ROOM, WABASH AVENUE STATION. THE NEGATIVE BATTERY ROOM IS IMMEDIATELY BELOW IT ON THE NEXT FLOOR.

both the largest direct-current lighting generator ever built and the largest double-current generator ever built.

The double-current generators and converse or inverted rotary-converter in the No. 1, or Harrison Street station, supply power over a duplicate transmission line to the No. 2, or Wabash Avenue sub-station, several views of which are given on the last few pages. The equipment of this rotary-converter sub-station consists of two 100-kw and two 200-kw, 125-volt converters and one 250-kw, 250-volt converter. These machines are controlled through the switchboard shown in Fig. 12, which is of special design gotten out by the Chicago Edison Company for its own use. The Wabash Avenue station also contains a 150-cell storage battery, capable of giving 528 amperes for 8 hours, or 2080 amperes for 1 hour. The load is carried, as a rule, by the polyphase apparatus and the battery, the steam equipment of this station being shut down except during the downtown peaks in the winter. There will, during the coming year, be put in the Wabash Avenue sub-station a pair of 30-kw, 60-volt boosters, direct-coupled to a 75-kw synchronous motor, taking current at the full line pressure,

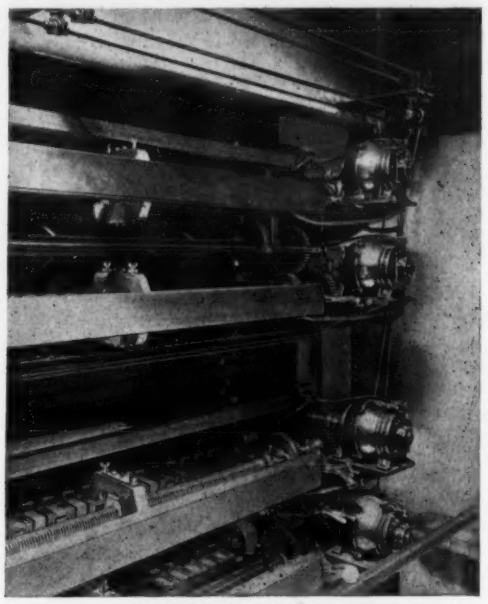


FIG. 15.—THE MOTOR-DRIVEN END-CELL SWITCHES OF THE WABASH AVENUE STATION.

4500 volts, this arrangement being preferable to boosters driven by direct-current motors, at it saves the corresponding capacity in rotary-converters.

The other high-tension transmission line from Station No. 5, at Market and Washington Streets, supplies two 100-kw rotary-converters in the North Avenue sub-station, an interior view of which is shown in Fig. 16. It was originally intended when these converters were purchased to put them in Station No. 4 at the Newberry Library, but the high cost of copper made it more profitable to install them in a separate location and thereby reduce the length of the direct-current feeders. Figs. 17 and 18 show front and rear views of the switchboard in this sub-station, which contains the most recent modifications of de-

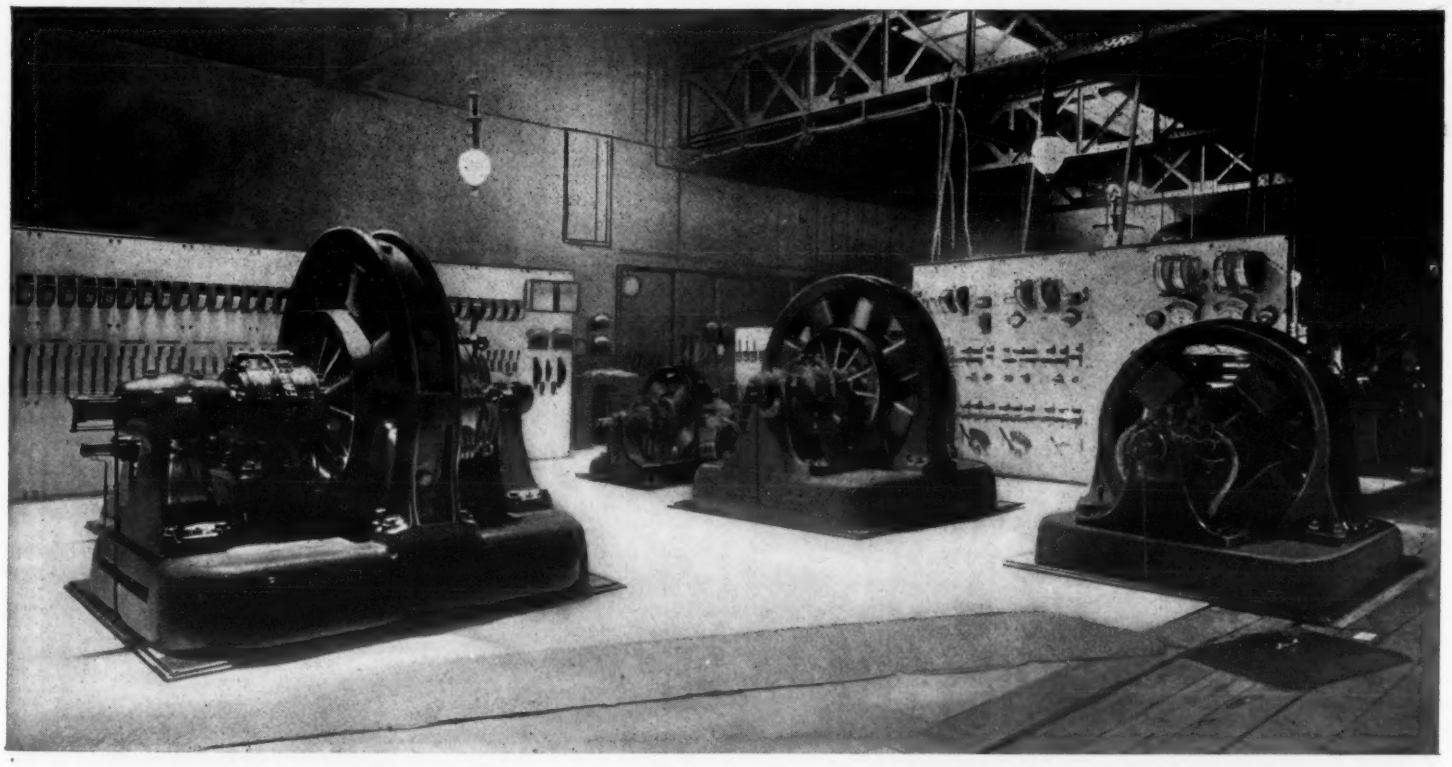
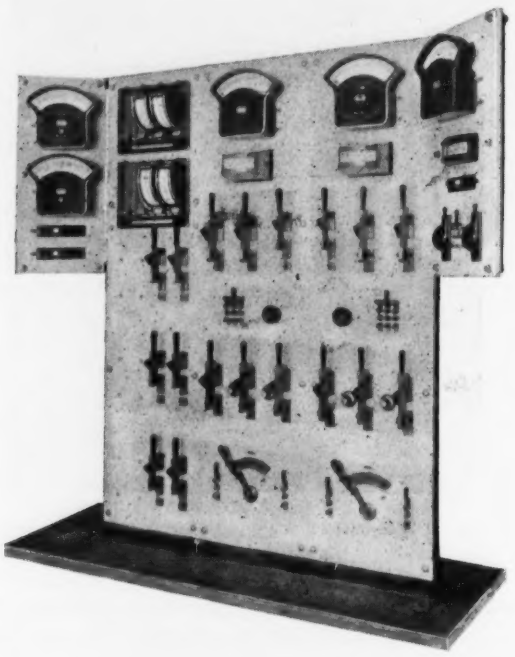


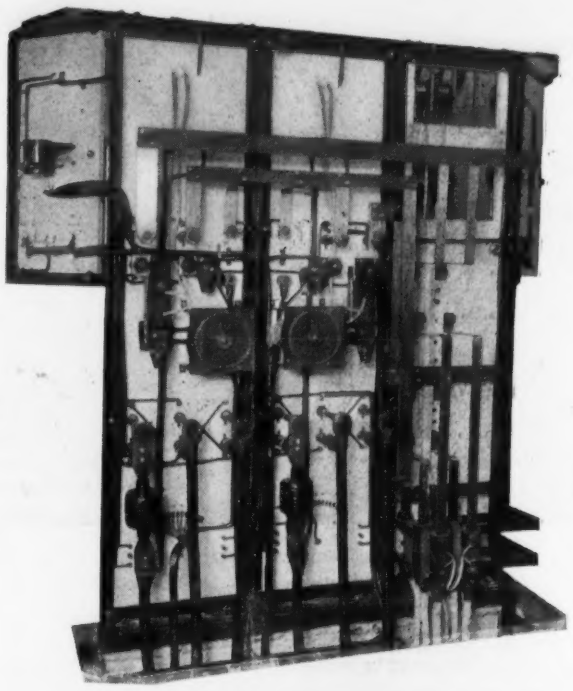
FIG. 14.—ANOTHER GENERAL VIEW OF THE ROTARY-CONVERTER UNITS IN THE NO. 2 OR WABASH AVENUE STATION.

sign developed by this company. It will be noticed among other things that the synchronizing lamps are placed down between the alternating-current switches, so that there is no need of the operator glancing down from his lamps at the top of the board to switches down below when synchronizing a machine. It will be noticed also from these views and the diagram, Fig. 19, that the field of the rotary-converter is connected to throw over switches by which it can be made bus-exciting or self-exciting, its purpose being to excite the field from the buses when starting from the direct-current end and to switch it over to the self-exciting position should it become necessary to start from the alternating end.

THE OLD AND NEW PLANTS OF THE COMMONWEALTH ELECTRIC COMPANY.

At the time of its organization, less than two years ago, the Commonwealth Company found itself in possession of nine generating stations, scattered from South Chicago to Evanston. These plants were in all cases of the primitive order of the last generation of central stations, containing small series arc machines and high-frequency, single-phase alternators of many makes, all belted to high-speed engines or countershafts. With many small stations of this kind the cost of operation was, of course, high per unit output. The company has already reduced the number of stations to four, three on the south side, and one with a sub-station on the north side, all of the west-side load being now carried from Station No. 5 of the Edison Company.





FIGS. 17 AND 18.—FRONT AND REAR VIEWS OF THE ROTARY-CONVERTER AND FEEDER SWITCHBOARD OF THE MOST RECENT TYPE DEVELOPED BY THE CHICAGO EDISON COMPANY, WHICH DESIGNS AND BUILDS ITS OWN BOARDS.

The North Avenue sub-station will be enlarged by the addition of one 150-kw, 250-volt rotary-converter, a novelty in the equipment of which will be an oil-insulated, water-cooled, 15-kw regulator. Station No. 4, at Newberry Library, will also be equipped with two 100-kw, 125-volt rotaries, which will be supplied from the 4500-volt, three-phase, 25-cycle lines, which, as noted above, will connect all five stations supplying the Edison network.

Adjoining Station A at Fifty-sixth and Wallace Streets on the south side, there is now under construction a model polyphase station which, when completed, will take the place of the three remain-

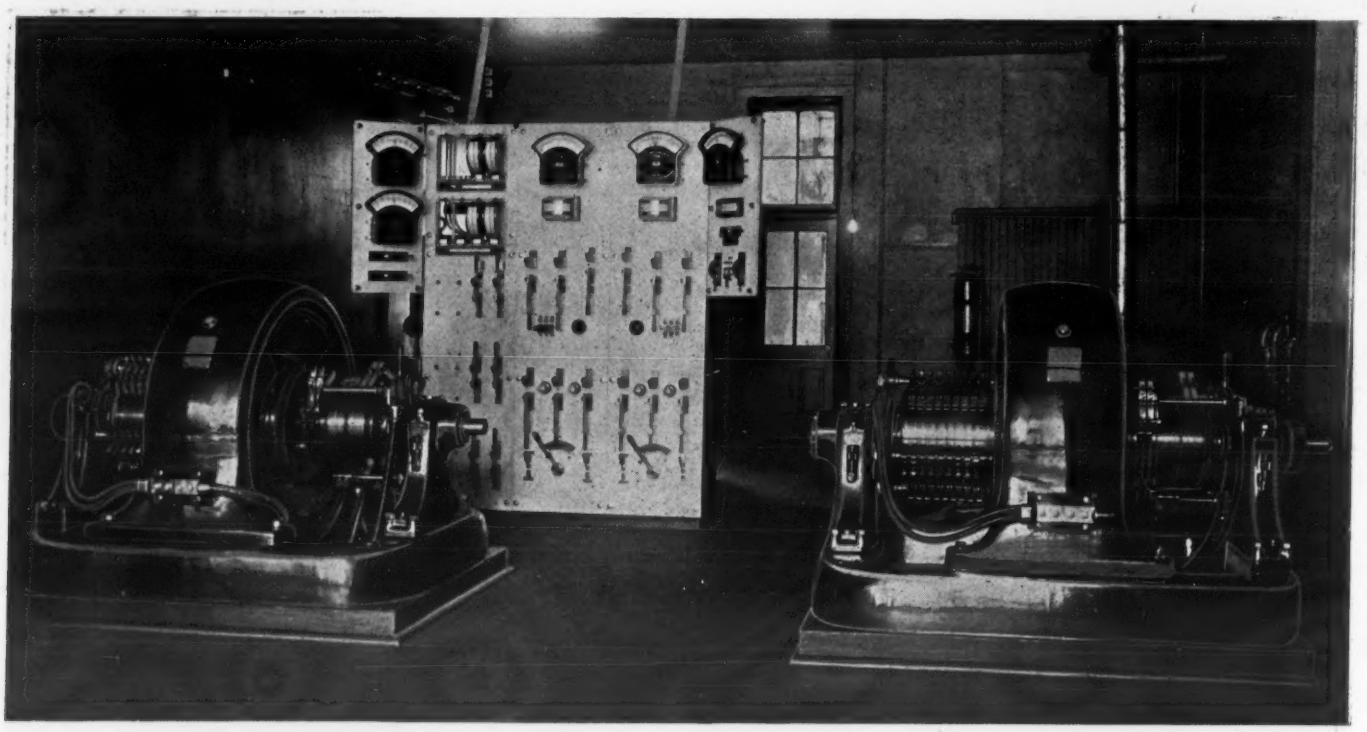


FIG. 16.—INTERIOR VIEW OF THE NORTH AVENUE SUB-STATION, CONTAINING 100-KW ROTARIES.

ENGINEERING LIBRARY UNIVERSITY OF MICHIGAN

ing stations on the south side and carry all loads in the great district of some 63 square miles, lying between Thirty-ninth Street and the southern limits of the city at the Indiana State line out beyond South Chicago and Lake Calumet. As this station represents the latest practice combined with several original features, a detailed description of its plans will be given here.

The new plant is located immediately beside the tracks of the Chicago & Eastern Illinois R. R., from which coal will be obtained, and just to the south of existing Station A, as shown in Fig. 24. The equipment at present ordered consists of one 400-kw and one 1000-kw three-phase alternator, and its entire output will consist of 60-cycle, three-phase currents. It will contain no arc machines, the present plans contemplating the use eventually of series-alternating arcs supplied through constant-current transformers or regulators from the alternating-current, constant-potential bus-bars. This part of the equipment has not, however, been definitely worked out in detail as yet, and the existing arc plants will be continued in service until the officers of the company arrive at a definite decision as to just how to treat the arc problem. The station is planned to utilize the existing overhead single-phase lines, which represent a considerable investment, and for this purpose, a novel and ingenious plan for splitting up the three-phase output into single-phase components has been developed by the engineering staff of the company.

The windings of the generators will be Y or star connected, with such a number of turns as to deliver 2300 volts between the common

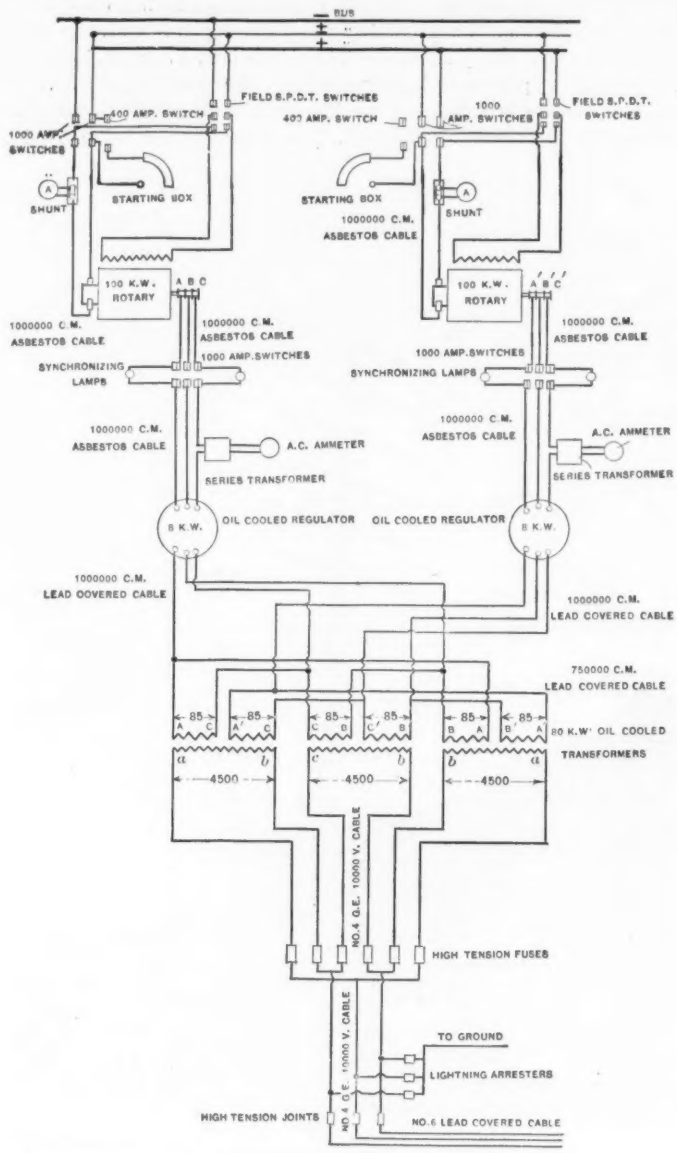


FIG. 19.—SCHEME OF CONNECTIONS OF TWO ROTARY CONVERTERS AS ILLUSTRATED IN FIGS. 16 AND 17.

junction of the Y and any outer terminal. A fourth wire will be brought out from the common junction, and each of the 2300-volt single-phase feeders will be connected between this fourth wire and one of the outer terminals, the feeders being divided in such a way as to balance the load. Arrangements have been provided for obtaining independent regulation on each feeder, for throwing the single-phase feeders to any desired phase of the bus-bars, and for running four-wire three-phase feeders for lights and motors. All of the general plans of the distribution system, as well as the details of the switchboard, etc., have been laid out by the engineering staff of the operating company.

The novel arrangement mentioned above as having been adapted for the balancing of the phases, is shown diagrammatically in Fig. 20. The three machine terminals, *A*, *B* and *C*, and the lead from the com-

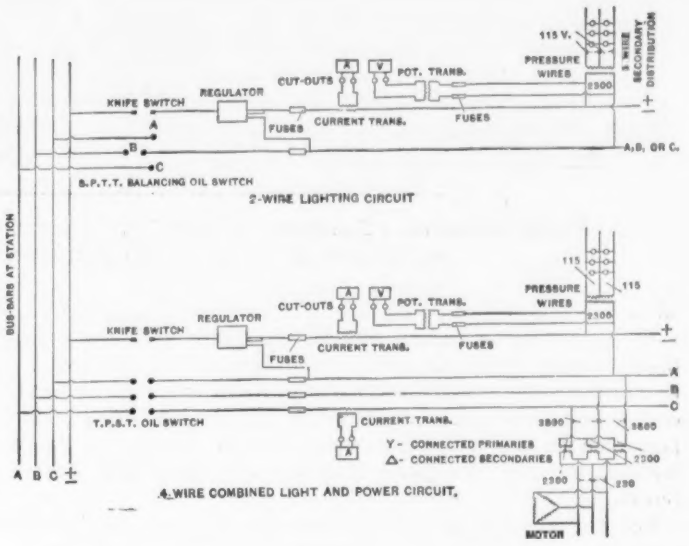


FIG. 20.—DIAGRAM SHOWING METHOD OF WORKING 2200-VOLT SINGLE-PHASE LIGHTING FEEDERS AND 2800-VOLT FOUR-WIRE THREE-PHASE. COMBINED LIGHTING AND POWER FEEDERS FROM THE SAME CIRCUITS.

mon neutral, make four bus-bars. Between the common neutral and any one of the three bus-bars *A*, *B* or *C*, the pressure is 2200 volts. Thus the voltage between any two of the outer terminals is $2200\sqrt{3}$ volts, or 3800 volts. The generators are thus 3800 volts, three-phase Y-wound with the common connection of the Y brought out to a fourth bus-bar on the board. The 2200-volt single-phase feeders are branched off from the 3800-volt three-phase bus-bars in the way shown in the upper half of the diagram. In one leg of the feeder there is connected a General Electric Form G oil switch with its contacts so arranged as to make it single-pole and triple-throw. The connections of this balancing oil switch, as it is called, are such that by means of it this leg of the feeder can be connected to any one of the three terminals of the three-phase circuit, *A*, *B* or *C*, the other leg of the feeder being connected through a potential regulator and knife switch to the common neutral. A pair of pressure wires with full primary voltage are brought back from the centre of distribution to give the station attendant an accurate means of observing the voltage at the distant end of the feeder, the idea being to obtain on the network supplied by this station as close regulation as is given on Edison underground service.

It is expected that a considerable induction-motor load can be developed among the light manufacturing establishments scattered along the many railroad tracks crossing the district fed by this station. For the supply of motors all three phases with 3800 volts are run out as shown in the lower part of the same diagram, the fourth or neutral wire being carried along for lighting purposes only. All lighting is carried between this neutral and one phase, and a potential regulator is connected in the neutral to give a means of adjusting the lighting voltage, no such care being necessary with the motor voltage. In this case also pressure wires are brought back from the lighting phase, and an ammeter is connected in the neutral lead to indicate the lighting load, another ammeter being connected in one of the outside legs not carrying the lighting load, this last ammeter showing the current going solely to the motors. The lights are to be carried on three-wire single-phase secondary mains, and the motors will be supplied from the 3800-volt primaries through transformers with standard windings wound for 2200 volts; these primaries being Y-connected so as to take the full 3800 volts, the secondaries being delta-connected so as to give 230 volts to the motors. The same Form G

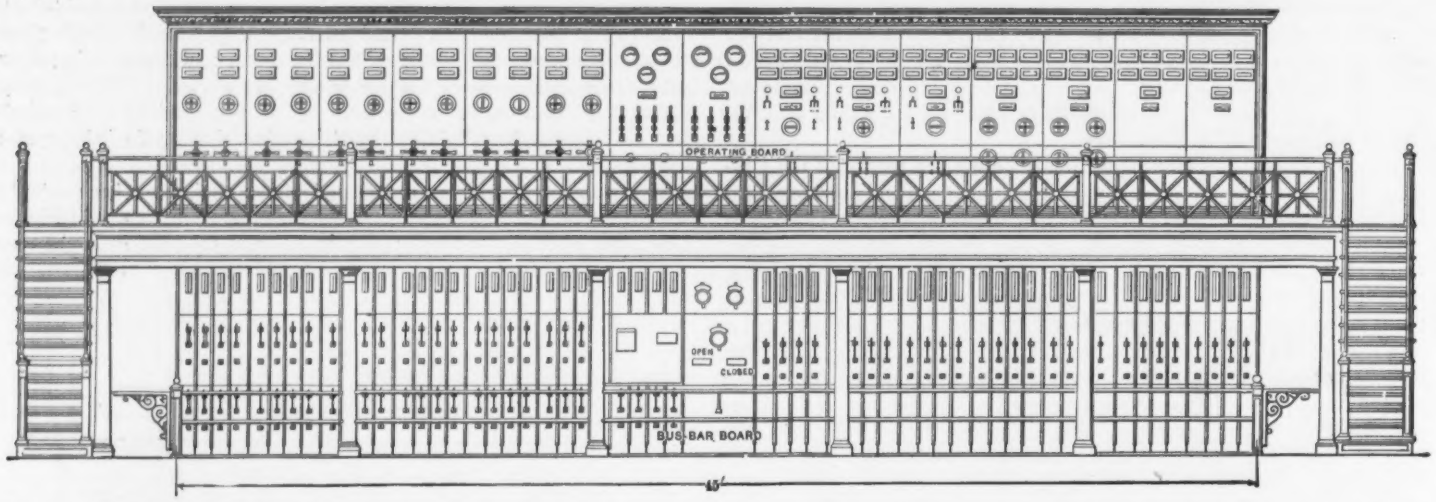


FIG. 23.—FRONT ELEVATION OF SWITCHBOARD BEING BUILT FOR THE 56TH STREET POLYPHASE STATION. THE OPERATING BOARD IS ABOVE THE GALLERY AND CONTAINS NO HIGH-POTENTIAL CIRCUITS OR CONNECTIONS WHATEVER.

oil switch is also used on the four-wire motor and light feeders, but with its contacts so rearranged that it becomes a triple-pole single-throw instead of a single-pole triple-throw switch. Indeed, a feature of the whole switchboard layout of this new station is the interchangeability of the panels. The bus-bar copper is so drilled that any panel can be used for a generator, for two single-phase two-wire feeders, or for a three-phase four-wire combined light and power feeder.

Fig. 23 shows a front elevation of the board from which its general arrangement can be seen. It is double-decked, the part above the gallery being made up of operating panels and getting no high potentials, the part below the gallery comprising what are called bus-bar panels, carrying switches and other apparatus which do not require frequent handling. Each bus-bar panel corresponds with the operating panel immediately above it. The whole board is 45 ft. long, being made up of 15 panels each 36 ins. wide. The panels of the board are made of White Italian marble with dead-black ironwork trimmings and oxidized bronze instruments, Tennessee marble being used for

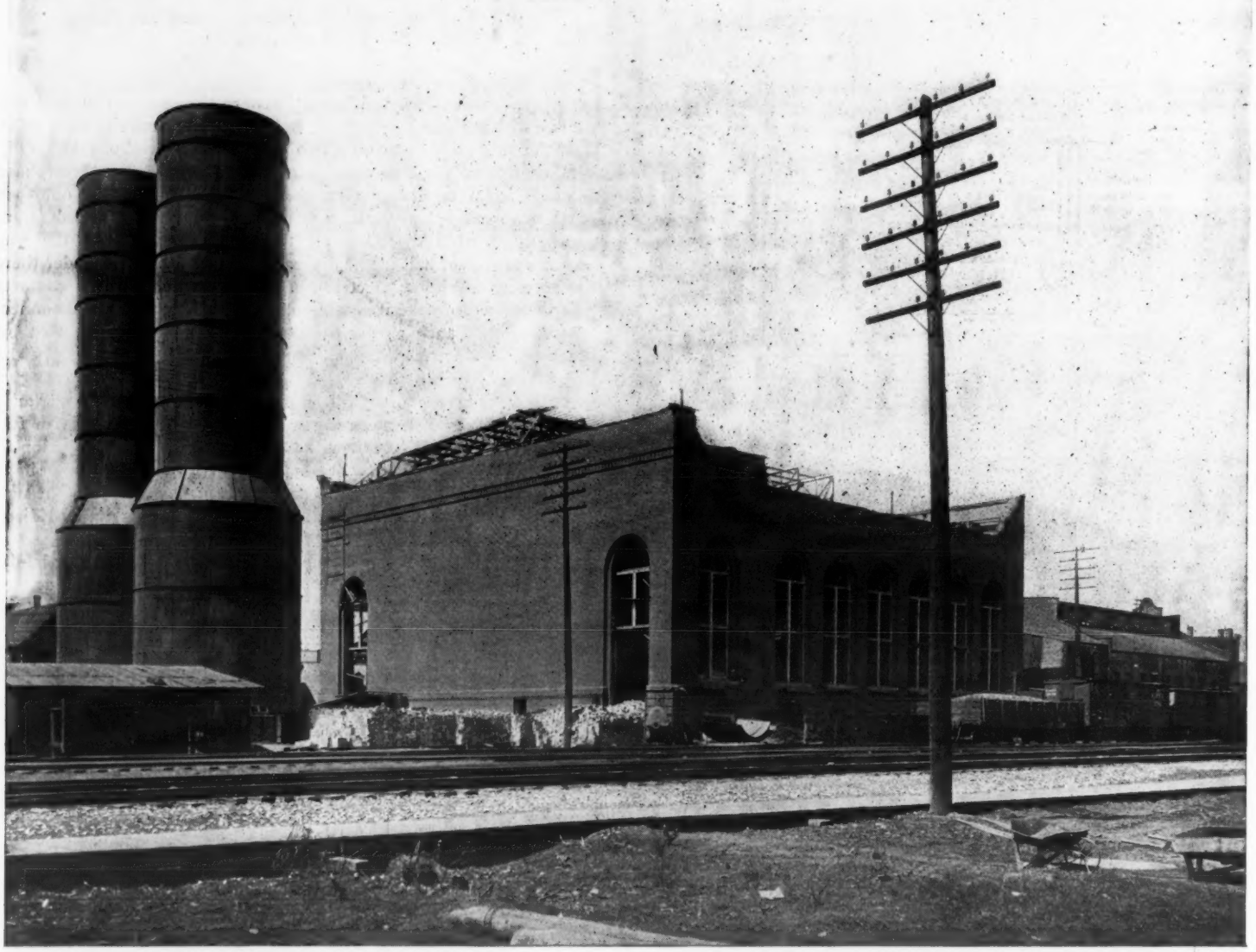


FIG. 24.—VIEW OF THE NEW 56TH STREET STATION, SHOWING COOLING TOWERS TO THE LEFT AND OLD STATION TO THE RIGHT.

the floor of the operating gallery. The structure is so designed that it can be extended in either direction without destroying its symmetry. New machines can be added and their panels placed properly adjacent to existing machine panels, since, as noted above, all panels are of the same width and the bus-bars are drilled behind all panels so that the latter can be interchanged.

It will be noted that the board contains no integrating instruments, with the exception of one wattmeter on the bus-bar panel that distributes current to the motor-driven station auxiliaries. Readings of the indicating instruments will be taken regularly, and recording or integrating instruments are considered an unnecessary duplication. One recording wattmeter will be mounted on an insulating stool with contacts such that it can be connected into the switch jaws of any bus-bar panel at any time when it becomes desirable to obtain the power factor or make any other test on any machine or feeder circuit.

The left-hand end of the board is occupied by feeder panels, there being two single-phase feeders per panel. For each feeder there are

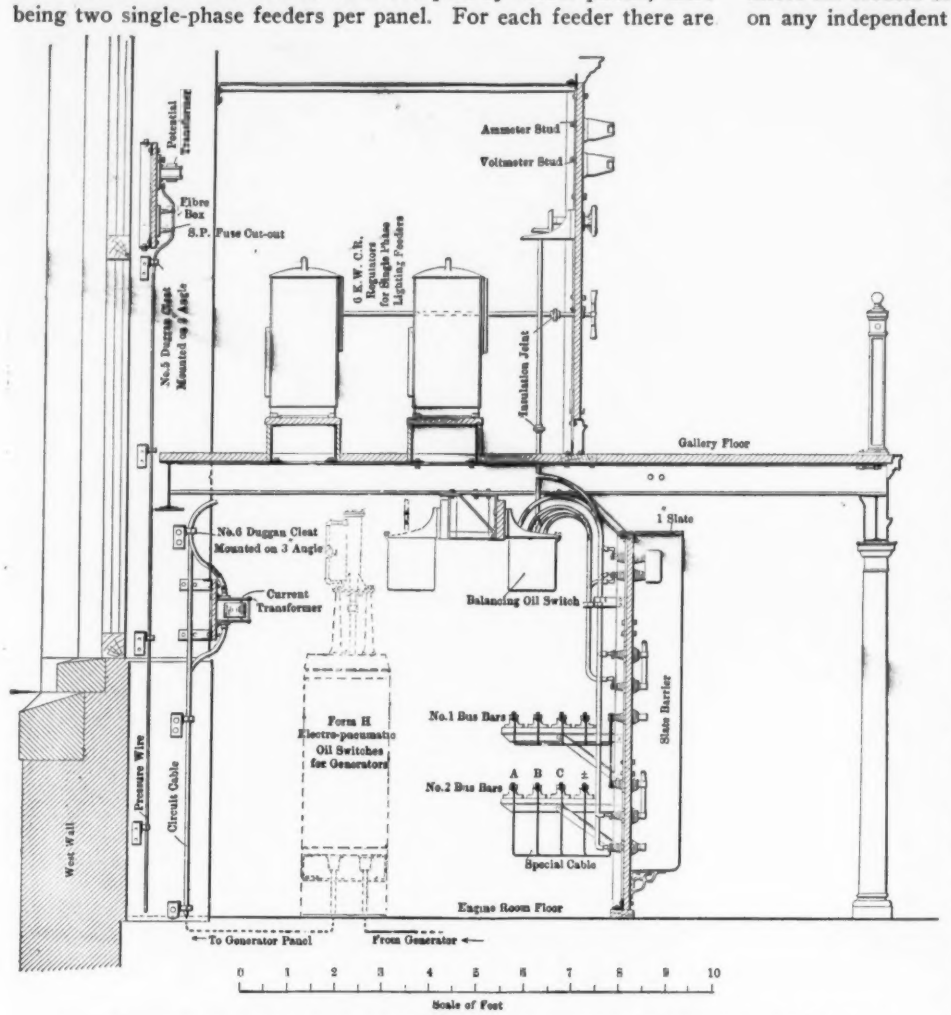


FIG. 25.—SECTION ACROSS THE SWITCHBOARD, SHOWING ARRANGEMENT OF BUS-BARS, OIL SWITCHES, ETC.

necessary on the bus-bar panel four double-throw switches in order to throw over from the main to the auxiliary bus-bars the neutral connection as well as the connections to phases *A*, *B* and *C*. Each of these switches has two independent knives of different lengths, so that the holes in their ends will not register in order that they may be separately thrown over. By this means any feeder can be transferred from one set of buses to the other without opening the circuit. The two bus-bars are normally in parallel with each other through a bus-bar tie switch. This tie switch for phases *A*, *B* and *C* is a Form H electro-pneumatic switch, the type recently developed by the General Electric Company, and described at length in these columns in an article on the polyphase equipment of the Metropolitan Street Railway Company. That part of the bus-bar tie switch connecting the neutral of the main and auxiliary buses is a Form F hand-operated oil switch, the lever of which appears below the ground-detector instruments on one of the centre bus-bar panels. There are also shown on this same panel two visual signals marked "Open" and "Closed." These are lamp signals designed to show whether the bus-bars are tied together or electrically independent.

To the right of this part of the board are shown three generator panels and four trunk-line, three-phase, four-wire panels. It will be noted that two of the trunk-line operating panels have each four wheel handles for operating four Form G oil switches. These two panels control the outgoing ends of duplicate feeders to a sub-station at Hyde Park, 16,000 ft. away. These four Form G oil switches in each feeder are intended for use when any one of the four wires of one feeder breaks down. In this case the connection normally running to that wire can be switched over either to the corresponding phase of the other feeder or to the neutral of the other feeder, one neutral being considered sufficient for service during such emergencies. The sub-station will, of course, be fitted with similar switches so that the corresponding connections can be made at that end. The conductors of these two 3800-volt, three-phase, four-wire trunk lines will be of No. 2 wire. The sub-station will be fitted with duplicate bus-bars, throw-over switches, balancing switches and potential regulators for feeders branching from it. It will be unnecessary to carry on any independent regulation at the sub-station during all but the heavily-laden evening hours, no attendant being necessary at all other times of day. During such times as there is no attendant at the sub-station the voltage of all sub-station feeders will be regulated at the machines, the voltage of all feeders from the generating station being independently controlled by the potential regulators in the outgoing ends of the feeders at the main switchboard of the generating station. Pressure wires will be run back from the sub-station to the generating station to give switchboard attendant at the latter point an indication of the sub-station voltage. Another trunk line will be run to a similar sub-station in South Chicago, nine miles away.

A section through the switchboard is given in Fig. 25, showing the arrangement of the apparatus. The type G R regulators for the feeders are mounted on the gallery behind the operating panels, and insulating joint being inserted between each regulator and its handle on the face of the board. Insulating joints are also put in the connections from the balancing switches to their handles on the operating board. All instruments are supplied from instrument transformers with grounded secondaries, and in this way no high potentials carried to the operating board. A few of the special features of this board, worked up by the engineering staff of the company are as follows: All series or current transformers of one rating will be interchangeable so that any transformer can be used yith any ammeter. Where an indicating wattmeter is used its series coils will be supplied from the current transformer of the ammeter of the corresponding circuit, and its potential coils will be supplied from the instrument transformer of the voltmeter of the same circuit. All instruments will be of the horizontal edgewise type; and the switches and similar fittings will be made by the General Incandescent Arc Light Company. Slate barriers will be put on the bus-bar panels between phases with slate covers at the top of the barriers, as indicated in the section through the board, Fig. 25. Owing to the high pressure used, special care will be taken with the wiring of the board. The bus-bars will be covered with varnished-cambric insulation treated with fireproof paint and will be supported on special-mold glass insulators. All cables around the board and from it to the overhead system, including even short jumpers down to a length of about 3 ft., are lead covered, the insulation being paper with a thickness of six-thirty-seconds of an inch. The outgoing cables will be carried down to the basement and up through an iron shaft to iron pipes, through which they will pass through the wall, the lead-covered cables being attached to the weatherproof wire on cross-arms outside the building.

The generators supplying the distribution system outlined above will be General Electric revolving-field machines of the usual type mounted between the cranks of Southwark vertical cross-compound two-bearing engines. One of the machines will have a capacity of 400 kilowatts and the other of 1000 kilowatts, extensions being

planned with the latter size. The company has been able to obtain from the engine builders an unusually high speed for units of such large size as 1000 kilowatts, viz., 150 r. p. m., which reduces the necessary number of poles for 60 cycles to 48. A motor controlled by a switch on the generator panel will be used to control the Porter-Allen governor of each engine in order to synchronize on the governor and adjust the division of the load between the units.

The engines will be condensing, exhausting into jet condensers, as indicated in the elevation through the station, Fig. 21 in the accompanying supplemental sheet of drawings. As the station is inland, cooling towers will be used and these will be of the Worthington natural-draft type, the first of this type used in this country. Two of these are now erected, as shown in Figs. 24 and 27. They are simply cylindrical boiler-iron shells, 80 ft. in height, mounted on brick piers over concrete water pans sunk below the ground level. The air pumps will force the hot water from the condenser discharge main to a height of about 16 ft. above ground within the cooling towers, at which level it flows over the top of a series of vitrified brick trays, becoming cooled in its passage down toward the water pan from which it is drawn by the condenser suction. The remaining portion of the cooling towers—above the point where the hot water enters them and flows over the uppermost tray—is solely useful for giving draft and carrying the water vapor to a height where it will not be objectionable.

The station will obtain its water from the city mains, and will have no primary heater in the exhaust of the main engines. A Cochrane auxiliary heater will be installed, taking the exhaust from the feed pumps and piped so that the exhaust of the air pumps and exciter engines can also be turned into it. The air pumps will normally exhaust into the intermediate reheating receivers between the high and low pressure cylinders of the main engines, and the exciter engines can be exhausted either into these receivers or into the open feed-water heater according to whether the exhaust of the feed pumps is or is not sufficient to heat the feed up to 212 degs.

There will be three 30-kw exciters, two of them engine-driven and one driven by an induction motor. Induction motors will also be used for driving the coal-handling apparatus. The overhead traveling crane will be driven by direct-current motors, for which the motor-driven exciter will serve as a source of power when not performing its nominal duty. The station will also be fitted to charge automobiles from the same source, provision being made for short-circuiting the series field of the exciter for such work.

The boiler room, see Fig. 26, now contains two batteries of double-decked Babcock & Wilcox boilers, making four boilers in all, rated at 500 horse-power each. The boilers have superheating coils, which appear clearly in the illustration, designed to intercept the hot gases after they have made their first crossing of the water tubes and before they make their second. The boilers are also fitted with Babcock & Wilcox chain-grate stokers. As the elevation of the station shows, space is provided for an economizer, which will not be installed for the present. For handling the coal there is installed a McCaslin coal conveyor and overhead coal bins with a capacity of 1000 tons, the hoppers of which appear in the boiler room view, Fig. 26. Coal will be received from the railroad track alongside of the building, the cars entering over a track scale and dumping into a crusher and cross-conveyor, which in turn delivers the coal into the main conveyor. This conveyor also travels over an overhead ash bin into which it will carry all ashes, this bin being provided with a chute by which ashes can be delivered into the cars on the railroad track.

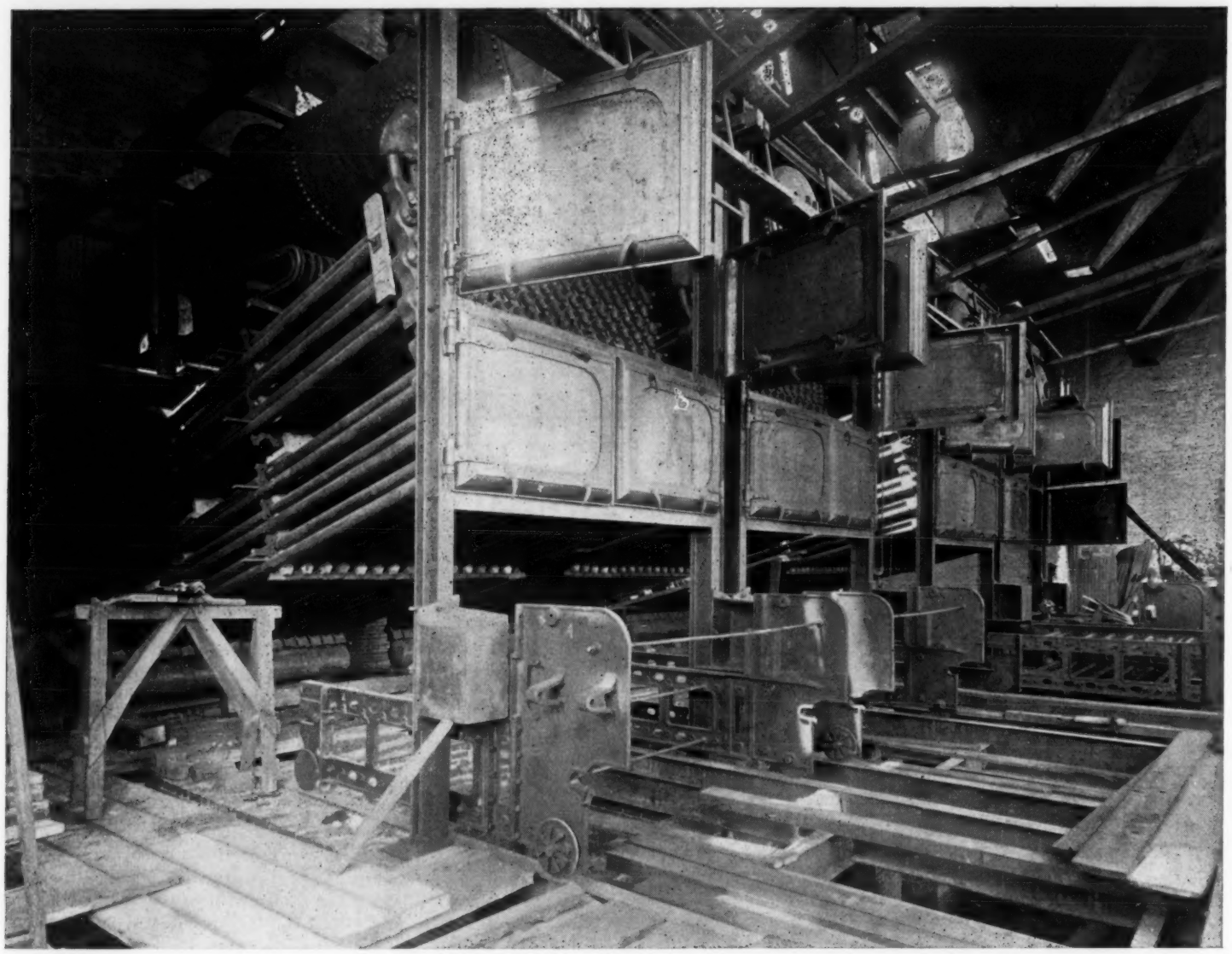


FIG. 26.—VIEW OF THE BOILER ROOM OF THE 56TH STREET STATION, SHOWING THE SUPERHEATING COILS IN THE BOILERS AND THE CHAIN-GRATE STOKERS.

The coal-handling and steam and water-piping systems of this station were laid out by Messrs. Sargent & Lundy, consulting engineers on this part of the work, the electrical details being handled by the engineering staff of the company itself, as noted above.

The building already erected has sufficient space for two more 1000-kw units and another battery of boilers. The north wall is temporary, the space now occupied by the old station being intended for an extension which will provide room for four more 1000-kw units, three more batteries of boilers, and another stack at the north end. There is also room for two more cooling towers beside those now erected. Thus the company has started on the construction of a station the ultimate capacity of which will be 10,000 horse-power, and—as must be evident to any one reading the above description—has endeavored to make the station of such an improved and high-grade type that it will not become out of date before its full ultimate capacity has been called into use and has seen a long term of active service. The whole aim has been to make this inland alternating-current station as permanent an investment and as economical in operation as the best of water-side low-tension stations, such as those of the Edison Company in the down-town district of the same city.

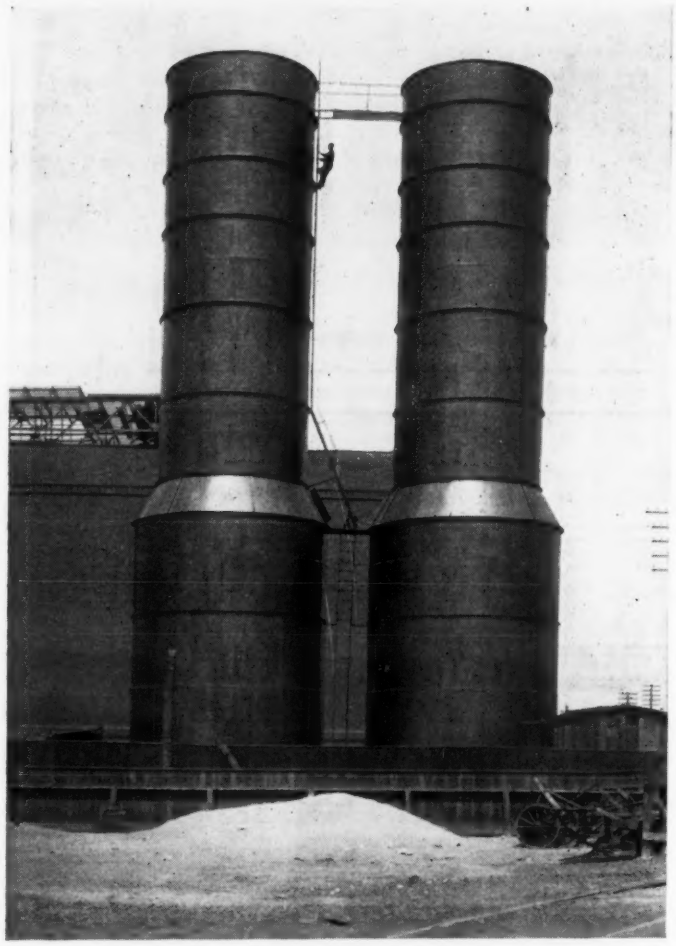


FIG. 27.—THE WORTHINGTON NATURAL-DRAFT COOLING TOWERS.

THE MUNICIPAL LIGHTING SYSTEM.

A large part of the streets of Chicago are lighted from plants owned by the city. This work is under the charge of the Bureau of Municipal Lighting, one of the five bureaus constituting the Department of Electricity of the city of Chicago. The municipal plants are four in number and contain similar apparatus, consisting generally of vertical marine-type cross-compound condensing engines of 500 to 800-hp sizes connected through clutch couplings to the ends of line shafts to which are belted Western Electric and Brush series arc dynamos of 100 to 160-light sizes The annual report of the Department of Electricity for the year 1899 shows the following interesting figures:

Miles of streets lighted by electric light	270
" " " gas	713
" " " gasolene	327
Total miles lighted	1,310
Operation and maintenance of municipal plants	$153,212
Cost of rented electric lights	55,222
" " gas	546,000
" " gasolene	141,211
Miscellaneous	16,944
Total cost of lighting per year	$912,589
Cost of electric lighting per mile of streets	$567.45
" gas lighting per mile of streets	784.60
" gasolene lighting per mile of streets	442.48
Average cost per mile	$654.48

The average number of arc lights supplied during 1899 from the four municipal plants was 2093, each of 2000 nominal candle-power, the number in service at the end of the year being 3502.

The cost of supplies, labor and renewals on the power-houses and lines amounted to $157,486; this includes $10,800 expended on renewals which is claimed by the department to cover depreciation. Per lamp this amounts to $54.43, to which is added $1.50 for the proper proportion of office salaries chargeable to arc lighting, making what is termed a "grand total cost per lamp" of $55.93 and an average cost per lamp per hour of $0.0138, although it is noticeable that these figures do not include any interest charge whatever. The electric lighting system is valued in the inventory at $1,155,272.

The annual report of the electrical inspection bureau of the city shows the following numbers of electric lighting stations and lamps under its jurisdiction:

	Number of Stations	Number of Arc Lamps Operated	Number of Incandescent Lamps in 16-cp. Equivalents
Commercial companies, central stations	49	17,613	512,229
Isolated plants	869	13,806	371,789
Municipal street lighting plants	4	3502	——

The large number (49) of central stations in this report as compared with the number owned and operated by the Edison and Commonwealth companies is due to the fact that many isolated plants supply current to their nearest neighbors and are classed in the report as central stations. Outside of these small block stations, as they may be called, all central station work is, as is stated above, carried on by the two associated companies.

Electricity in Cotton Mills.

Mr. Sidney B. Paine, of Boston, delivered a lecture, illustrated by lantern slides, on "The Development of the Cotton Drive," before the Southern Cotton Spinners' Association at its recent meeting in Charlotte, N. C. He described the development of the electric system in textile mills of the United States, and gave the reasons which led manufacturers to adopt the electric drive in their mills. The electric system did not, he said, increase the original investment by the amount of money paid for the electrical equipment. In many items the first cost was greatly reduced. Ordinarily no separate lighting dynamo was required, the current for the electric lights being taken from the same generator which supplied current to the motors. In a large mill these savings would go very far toward paying the first cost of the electric system. Mr. Paine discussed various economies following the use of electricity in mills, and declared that the first cost of the electrically-driven mill would probably be less than that of the mechanically-driven mill in which provision for enlargement was made. The cost of the engine and its foundations for the latter mills would be considerably higher than that of the mill using the electric system. The shafting in the mechanically-driven mill being much larger than was necessary for the present building would be very much more expensive than that required in the electrically-driven mill.

Automobile Exposition in Nuremburg.

United States Consul Weber, at Nuremburg, Germany, informs the State Department that an automobile exposition will be held in that city between June 1 and July 1 next, at which all kinds of automobiles will be exhibited. The exposition will cover an area of but one acre, but machines will be shown in the city as well as at the exposition. Races to neighboring cities will take place. Some Austrian vehicles will be shown, but France, Belgium and England will not be represented on account of the greater attraction at Paris at the present time. The Schuckert Company will improve this occasion to make an exhibit of its latest inventions of automobile motors, etc.

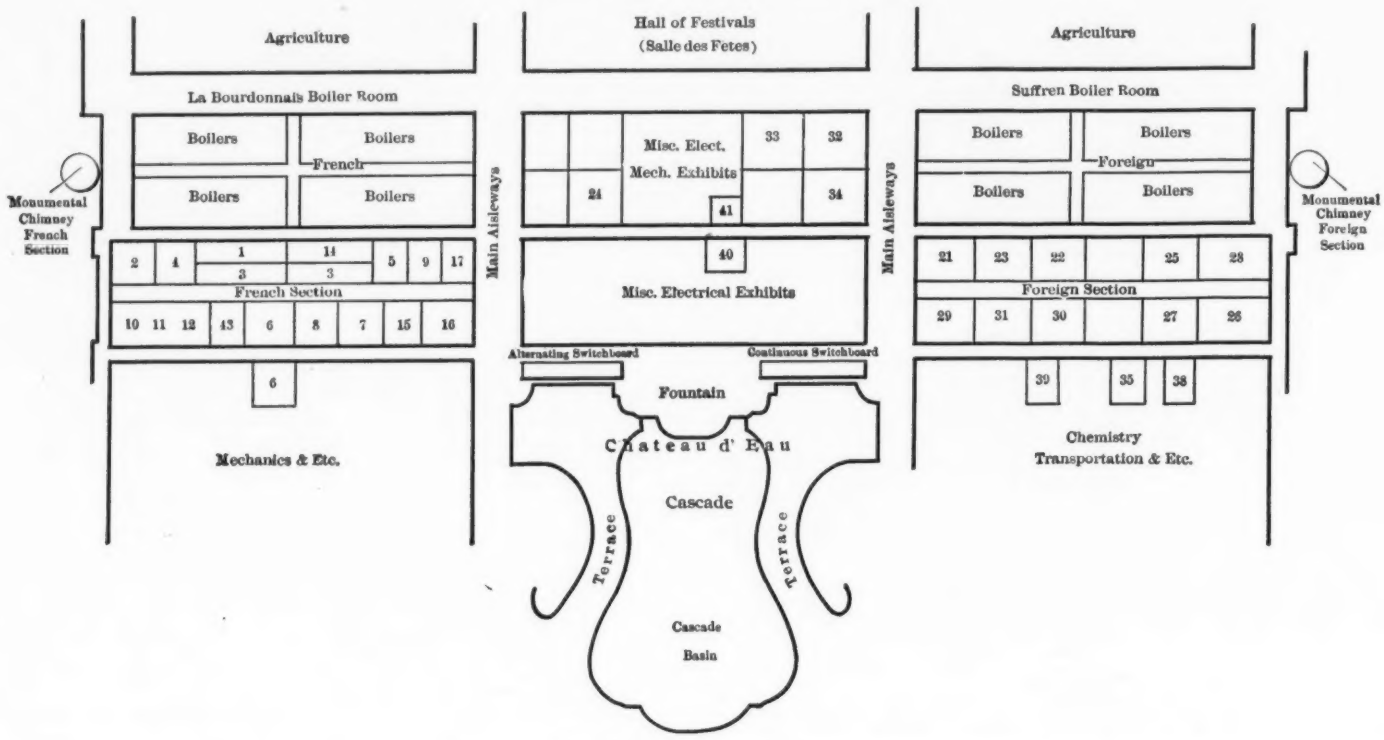
Electric Light and Power at the Paris Exposition.

IT would in no wise be amiss or improper to speak of the Universal Exposition of 1900 at Paris as an electrical exhibition, because its whole scheme so far as relates to the arts and industries is based on the use of electric current, its lighting being done by electricity, its transportation being entirely furnished by electricity, its machinery of all classes being driven by electricity, and a great many of its fascinating novelties owing their success or their very possibility to electricity alone. Each successive universal exposition does in fact but constitute a new opportunity for this subtle agency to show how long and rapid have been its strides in the few intervening years; and the new tasks of subserving public convenience and utility that are thus taken up so easily with each new occasion, furnish the best possible means of educating the world at large into the freer use not only of the oldest but also of the latest applications of the current.

Under the conditions governing at Paris, therefore, an enormous demand for current was to be anticipated, and equally as might have been expected, provision for its supply has been made on a most extensive scale. It may be questioned whether anywhere else a plant at once so large and so interesting could be found as that which occupies the chief part of Electricity Building, stretching out on both sides around the flanks of the Water Palace—Chateau d'Eau—into the departments of Machanics and Transportation, and occupying as its necessary annex also the big steam plant lying in the open sheds between the two monumental chimneys. Quite apart from its functions, the plant is of the deepest interest from its variety of types, sizes and methods of operation. It is certainly the largest installation, by long odds, in all Europe; even the latest power plants in America are equaled as to present magnitude, while it remains true that the opportunity of study is unique. Obviously it is the duty of any constructing or consulting engineer to render a power plant homogeneous and uniform, and to approximate all his apparatus to the standard alopted for each class. At Paris, heterogeneity is the keynote, and with the diversity of types has also arisen a diversity of problems for the engineers in charge, complicated by all the difficulties associated with temporary work, changing requirements, and the fact that above all the plants must always be "en parade." At Chicago in 1893 the steam plant did at least get one day in seven for an overhauling; but at Paris, Sunday is the time when the crowd goes to the show, and everything must be in its best shape, as much in Groups 4 and 5 with their ponderous engines and dynamos, as in the side shows with their music or the "diversified industries" with their dainty bits of china and carving for women to pick up and examine.

Electricity Building, on the Champ de Mars, has a total length of 1365 ft. and a depth of 260 ft., part of it stretching across the ends of other large buildings, all being enclosed by a common roof of glass with awnings, the awnings in each section giving the generic name of the exhibits there to be found. That part of the front of Electricity Building exposed to the Champ de Mars is 513 ft. with a height at the tip of the star on its façade of about 231 ft. It is directly behind the Chateau d'Eau, or Water Palace, and its ground floor is in effect a basement to that structure, as the inclined pathways around the cascade conduct to the galleries on the first floor and to the Courts of Honor. In this building are grouped not only all the dynamos and engines, but all the general and miscellaneous electric exhibits of

THE OLD MACHINERY HALL OF 1889



FRENCH SECTION.		FOREIGN SECTION.	
1. Société Alsacienne de Constructions Mecaniques.	10. Daydé & Pillé—Weyher & Richemond.	21. Robey (England).	32. Siemens & Halske—Ringhoffer (Austria).
2. Decauville Aine Paris—Crepelle & Garaud.	11. Cie Gle. Electrique Nancy—Weyher & Richmond.	22. Siemens Bros.—Willans & Robinson (England).	33. Ganz—Erste Brunner (Aus.).
3. Maison Breguet—Société de Laval.	12. Soc. Hyd. & Elec.—Weyher & Richemond.	23. Mather & Platt — Galloway (England).	34. Ganz—Lang (Hungary).
3. Maison Breguet—Société de Laval.	13. Maison Breguet—Delaunay Belleville.	24. Electrot. Industrie—Storck (Holland).	35. Oerlikon Wks.—Sulzer (Swiss).
4. Compagnie de Fives—Lille.	14. Cie Thomson-Houston—Soc. Cail.	25. Soc. Helios—Augsbourg (Ger.).	" " —Escher Wyss (Swiss).
5. A. Grammont—Piguet & Cie.	15. Schneider & Cie—Dujardin & Cie.	26. Soc. Schuckert (German).	39. Alioth—Mertz (Swiss).
6. Etabs. Postel-Vinay—Garnier.	16. Soc. Anon des Hauts—Fourneaux de Maubenge.	27. Siemens & Halske—Borsig (German).	40. Schuckert—Tosi (Italy).
6. " " " "	17. Cie Gle. Electrique Nancy—Soc. des Indus. Mecaniques.	28. Lahmeyer (German).	41. Bacini—Tosi (Italy).
7. Soc. l'Eclairage Electrique—Dujardin & Cie.		29. Kolben—Carels (Belgian).	
8. Soc. l'Eclairage Electrique—Bietrix, Nicolet & Cie.		30. Soc. Elec. & Hyd.—Bollincks (Belgian).	
9. P. & A. Farcot.		31. Pieper—Van den Kerchove (Belgian).	

In each group, the first name given above is that of the dynamo builder. The second name, after the dash, is that of the engine builder. The country of origin is indicated for the foreign section.

FIG. 1.—GROUND FLOOR PLAN, ELECTRICITY BUILDING AND ANNEXES.

whatever character. Back of the building again is the boiler plant, which, like it, is also divided into two sections, French and foreign. The former generates steam for the French units and the latter for all of the foreign units. The boilers are massed in two double rows in each section, with one interior and two exterior aisles, and transverse aisles, allowing a plentiful supply of air; and the whole on each side is sheltered by a lofty steel open roof. Each boiler room is about 340 ft. by 92 ft. The concerns represented will be found in the following list with the number of boilers: Rosey, 6; Cie de Fives-Lille, 3; Montupet, 6; Bietrix, Leflaive, Nicolet, 1; Solignac, Grille & Cie, 1; De Nayer & Cie, 10; J. & A. Niclausse, 21; Crepelle-Fontaine, 1; Soc. des Generateurs Mathot, 7; Cie Babcock, Wilcox, 14; Galloways, Ltd., 6; Fitzuer & Gamper, 1; Steinmuller, 5; Petzold, 1; Simonis & Lanz, 1; Paucksch, 2; Ewald Berninghaus, 5, and Petry-Dereux, 1, making a total of 92 boilers. Of these, 50 are in the French, or Bourdonnais, section, and 42 in the foreign, or Suffren. They are almost without exception multitubular water-tube in type, and some of the exhibitors are in both sections. The total heating surface is about 160,000 sq. ft., with a grate area of 4240 sq. ft. The steam pressure at the boilers is 156 lbs. to the square inch, and at the engines is 140 lbs. The capacity of the boilers is put at over half a million pounds of steam per hour, and the steam is taken by 10-in. mains to equalizing cylinders, whence it is distributed. The gaseous products of conbustion are carried down and discharged by large flue tunnels into two superb "monumental" chimneys, one for each section. These chimneys, illustrations of which were given on page 578, issue of April 21, are 260 ft. high, with an external diameter at the base of about 40 ft. and an internal diameter of 20 ft. 4 in., tapering to 14 ft. 9 in. at the top. The smoke flues are in some instances 15½ ft. high and 8½ ft. wide, while there are tunnels of hardly less generous proportions for the steam pipes and condensing water pipes. The tunnels for these pipes extend all told about 4700 ft., in three different sizes.

FIG. 2.—BOILER ROOM, FOREIGN SECTION, OPENING WEEK.

FIG. 4.—CHATEAU D'EAU AND ELECTRICITY BUILDING.

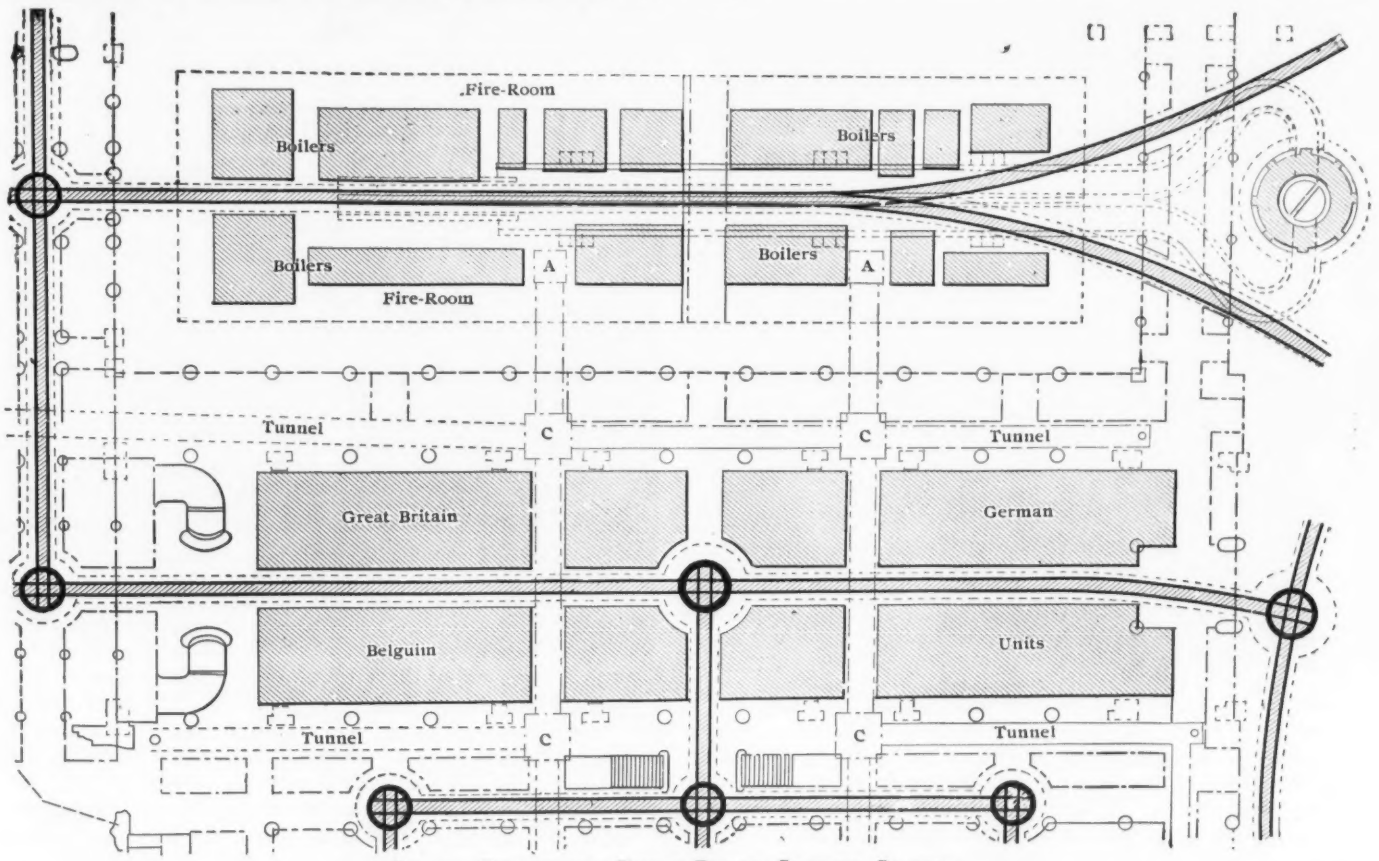


FIG. 3.—ENGINE AND BOILER PLANT, SUFFREN STATION.

Great care has been taken to render this part of the Exposition a feature of interest and, as far as possible, of beauty. The two chimneys with their colored brick designs and their huge plaques of rich faience ware are delightful to look upon, and all the approaches are

light and airy. While it is impossible to keep things as clean with coal fuel as with oil or natural gas, efforts are made to reduce the amount of dirt, and both the coal and the ashes are handled in small sacks. The flues and the piping being underground, there is a minimum of annoyance from heat, smoke, drip, etc. Moreover, the whole scheme of the Chateau d'Eau, or Water Palace, may be said to be subordinated to that of the steam plant, spectacular as it is in and of itself. At the banks of the Seine, on one side of the Champ de Mars, the French Worthington Company has a very fine separate pumping station, in a building of its own, with four pumps capable of delivering 40,000,000 gallons per day of 24 hours. This water is pumped up to the reservoir in the central niche of the Chateau, through two 30-in. mains crossing the bed of the cascade basin. The feed water is drawn from this reservoir or upper basin as well as any water required for fire protection, cooling the cylinders of gas engines, etc.; while from the lower basin the water for condensation with surface condensers passes into circulation; all the warm water being collected and returned into the Seine. The water used performs therefore a large part ornamentally in cascades and fountains, being beautiful by day and even more so by night with the aid of electric light playing over it and beneath it.

Turning now to the electrical generating plant, the list and variety of units is in its way as extensive as that for the steam plant. A diagrammatic plan is given herewith showing the disposition of the units, with the names of the builders of the dynamos in each case. The capacity and output of these units is as follows:

FRENCH SECTION.

Dynamos.	Ind. H.P.	Power in K.W.	Nature of Current.	Amperes.	Volts.	Frequency.
1. Soc. Alsac. Cons. Mec.	1200	675	Direct	1400	500	——
2. Decauville Aîné.	1200	675	"	2800	250	——
3. Maison Breguet.	300	170	"	700	250	——
3. " "	300	170	"	700	250	——
4. Cie Fives-Lille.	1200	675	3 Ph.	180	2200	50
5. A. Grammont.	600	340	3 Ph.	90	2200	50.
6. Postel-Vinay.	400	225	Direct	450	500	——
6. " "	135	75	"	150	500	——
7. Soc. l'Eclaire. Electrique.	800	440	3 Ph.	95	3000	50.
8. " " "	350	190	Direct	760	250	——
9. P. & A. Farcot.	850	480	2 Ph.	155	2200	42.5
10. Dayde & Pillé.	1000	560	Direct	2240	250	——
11. Cie Gen. Elec. Nancy.	500	280	3 Ph.	52	3000	50
12. Soc. Electrique & Hyd.	1000	560	3 Ph.	150	2200	50.
13. Maison Breguet.	1250	700	3 Ph.	190	2200	50.
14. Cie Thomson-Houston.	1200	675	3 Ph.	65	5500	25
15. Schneider & Cie.	1500	840	3 Ph.	230	3000	50
16. Soc. Anon. Hauts—Fourneaux Maubenge.	500	280	Direct	1120	250	——
17. Cie Gen. Elec. Nancy.	120	65	"	260	250	——

FOREIGN SECTION.

Dynamos.	Ind. H.P.	Power in K.W.	Nature of Current.	Amperes	Volts.	Frequency.
21. Robey.	500	280	Direct	1120	250	——
22. Siemens Bros.	2400	1340	"	2630	500	——
23. Mather & Platt.	500	280	"	1120	250	——
24. Elect. Industrie.	550	300	"	600	500	——
25. Helios Elek. Aul. Act. Ges.	1900	1020	Sing.Ph.	480	2200	50.
26. Schuckert.	2000	1120	3 Ph.	100	5000	50.
27. Siemens & Halske.	2230	1250	3 Ph.	340	2200	50.
28. Lahmeyer.	1400	785	3 Ph.	95	5000	50
29. Kolben.	1000	560	3 Ph.	150	3000	50
30. Soc. Elec. & Hyd.	1100	620	3 Ph.	170	2200	42
31. Pieper.	1000	560	3 Ph.	150	2200	50.
32. Siemens & Halske.	1600	900	Direct	1800	500	——
33. Ganz.	910	510	3 Ph.	140	2200	42
34. Ganz.	1200	670	3 Ph.	180	2200	50.
35. Oerlikon Works.	400	250	Sing.Ph.	110	2200	50
38. " "	900	500	3 Ph.	135	2200	50.
39. Alioth.	360	200	Direct	400	500	——
40. Schuckert.	1200	675	"	1400	500	——
41. Bacini.	600	350	"	700	500	——

These lists show a total of 20,245 kilowatts, with 36,155 i. h. p. for the 38 groups or units. This is divided up among 20 continuous (direct) current units of 8260 kilowatts; 2 single-phase units of 1270 kilowatts; 1 two-phase unit of 480 kilowatts and 17 three-phase units of 10,235 kilowatts. The proportion of the whole supplied by France is about as 8 is to 12. The Schuckert and Labmeyer three-phase units will also deliver equivalent direct-current at 250 volts. The No. 17 French unit is driven by a gas engine, and has been a very useful plant during all the long provisional period of preparation.

Current from all the various units is led by underground cables to two long marble switchboards, which will be very handsome when finished, but which on the last day of April were by no means in shape to be photographed. They are immediately behind the Chateau d'Eau, on the ground floor of Electricity Building, that to the left as one faces the building taking all the alternating current, while that on the right all the continuous current.

FIG. 5.—BABCOCK & WILCOX BOILERS, FRENCH SECTION, CHAMP DE MARS.

It should be added at this point that in addition to this service, a large amount of current can be, and is, drawn from outside the grounds. The electric lighting companies for the sections of the

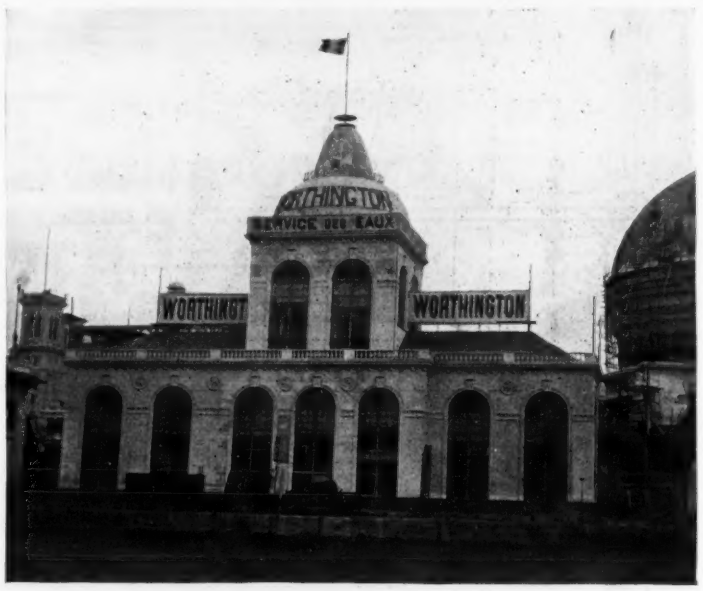


FIG. 6.—WORTHINGTON STATION FROM THE RIVER.

Champs Elysees and of the left bank of the Seine are under contract to meet any demand on them up to a total of 800 kilowatts for each; and the current for the moving sidewalk and the third-rail system is also taken from an exterior plant. The French Worthington Company also have a neat plant for themselves driven by De Laval turbine, and the United States Commission has a separate Western Electric plant in Electricity Building for special lighting. There are probably a few other installations of this nature in "concessions," such as the Eiffel Tower, which is just enlarging its own plant. In fact, as was intimated not long ago in these pages, the demand tends to increase all the time as new buildings or exhibits find they are ready but have not provided for light. It thus happens that the Railway Company of the West has just made an arrangement with the authorities to place

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at their disposal a part of the current intended for haulage of trains on their sunken track between the Invalides and Champ de Mars wings of the Exposition.

The total expenditure of the Exposition authorities on account of the mechanical and electrical part of their work is placed at not less than $1,600,000, in official figures, of which $840,000 is for the steam plant and $220,000 for the pumping plant; $325,000 for the electrical installations, and $220,000 for management, cranes and various odds and ends. But outside the cost of their apparatus, it is estimated that those who supply the mechanical energy will make a present to the

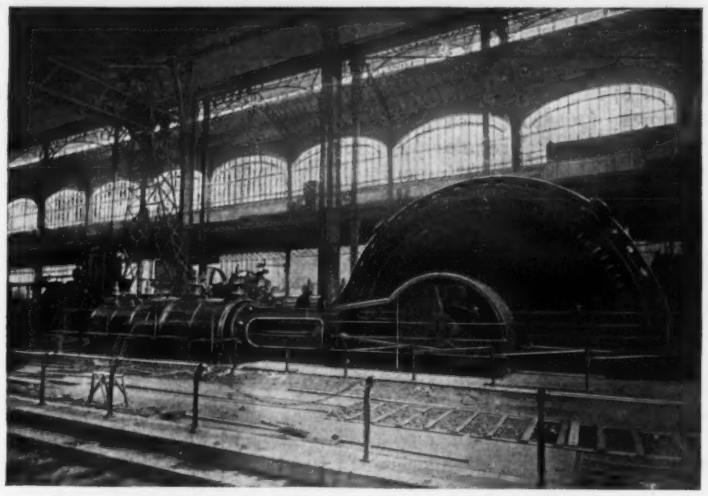


FIG. 7.—DIRECT-CONNECTED ENGINE AND DYNAMO, AUGSBURG ENGINE COMPANY—HELIOS ELECTRIC COMPANY, GERMAN SECTION.

Exposition of about $400,000, and that those delivering current will sustain a proportionate deficit. The installation payment to exhibitors in "service" for units under 1000 horse-power is $19.90 per horse-power for the engine and $8.16 for the dynamo; from 1000 horse-power up to 1500 horse-power it is $14.20 and $2.50; and above that size, $10.40 and $1.90. For service a minimum of 500 hours of operation is guaranteed, and the payment, by meter, is made to the exhibitors at the following rates: Up to 1000-hp units, engine 1.68 cents and dynamo 1.41 per hp-hour; 1000 to 1500-hp, engine .76 cent

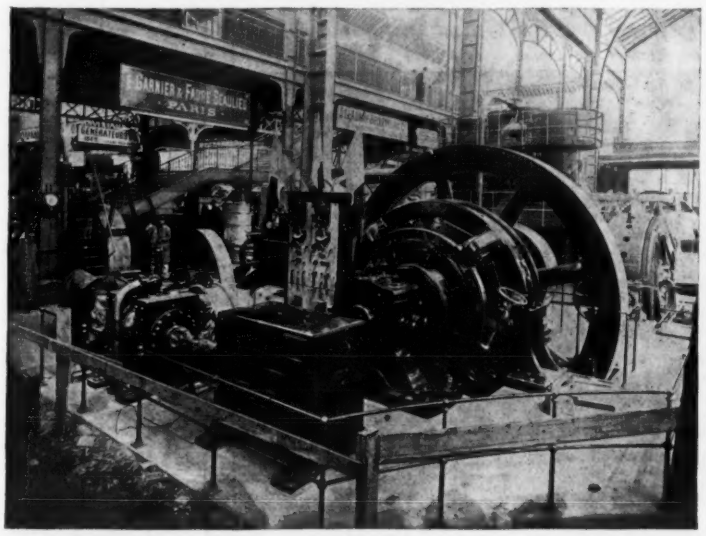


FIG. 9.—POSTEL-VINAY DIRECT-CONNECTED, 440-VOLT GENERATOR.

and dynamo .58 per hp-hour; above 1500-hp, engine .57 cent and dynamo .48 per hp-hour. Steam is furnished free to the units. The compensations to the boiler exhibitors, to whom water is furnished free, is about in keeping with the above rates, which have not, however, prevented the assemblage of a very fine plant. M. Picou, the electrical engineer in charge, states that the exhibitors are carrying out their agreements so fully that there will be at least 33 direct-connected units in operation as previously indicated, ranging from 500 horse-power up to 2400 horse-power.

Governed by a variety of conditions that need not be here discussed, but many of which will be obvious from the variety of type and apparatus exemplified in the lists given, a certain class of current had to be allotted to a given portion of the Exposition. It is true that the authorities might have insisted on one type of current, say three-phase, and then handled that by static and rotary transformers as is done from a central station of the modern school, but the opportunity to install and exhibit different forms and types of machines would at once have been sacrificed and many exhibitors would have been cut out. The distribution of the current therefore has been laid out as follows: All the buildings of the Champ de Mars, direct current,

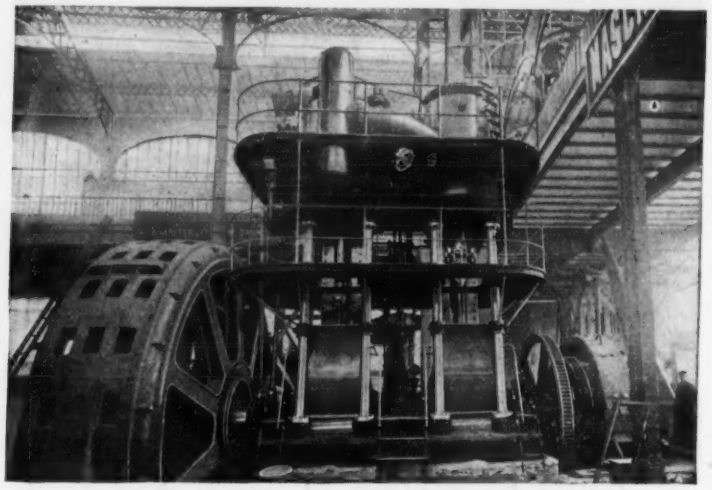


FIG. 8.—DIRECT-CONNECTED ENGINE AND DYNAMO, CONSOLIDATED AUGSBURG AND NUREMBERG ENGINE COMPANY—LAHMEYER ELECTRIC COMPANY, GERMAN SECTION.

three-wire, 220 volts, up to the Eiffel Tower, with a fringe of alternating, single-phase, 115 volts around the whole outer edge of that block. All around the Eiffel Tower, alternating current, single-phase and three-phase at 115 volts is delivered for use, and this is true of the colonial sections in the immediate vicinity of the Trocadero

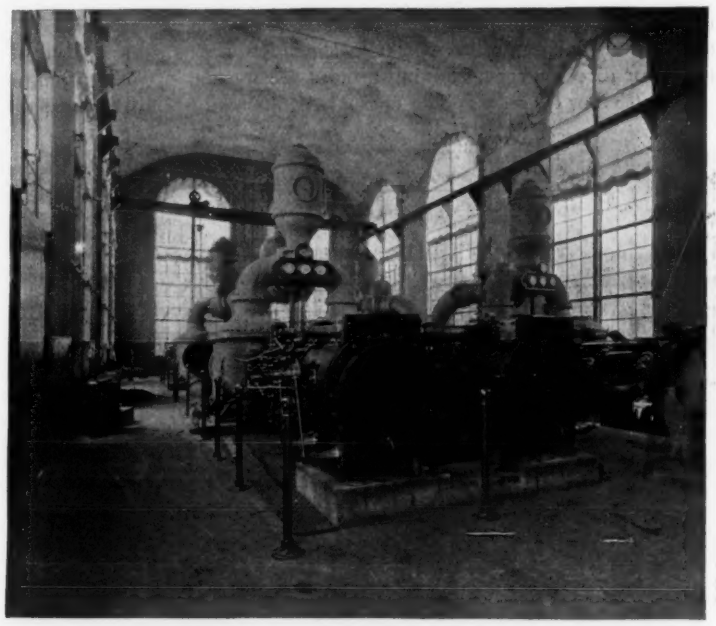


FIG. 10.—INTERIOR OF WORTHINGTON PUMPING STATION.

Palace, as well as of the right bank of the Seine from the Trocadero Garden up to and including Old Paris. The part of the Trocadero exhibits at the slope of the Pont d'Jena has alternating three-phase, 115 volts, and this same current is also available along the whole left bank of the Seine, from the Worthington pumping station at one end clear away to the Esplanade des Invalides. It serves also all that area and both the right and left banks beyond, including the new bridge of Alexander Third and reaching the Monumental Gate of entrance on the Place de la Concorde. Immediately within the Gate, however, and including all the roughly triangular area occupied by the two

great buildings of Fine Arts and their annexes, the current is direct, two-wire, at 560 volts. (The diagram on page 653, of the issue of May 5, gives a graphic representation of the current distribution.) From the switchboards the current is taken by heavily armored underground cables just laid in bare earth trenches without any pro-

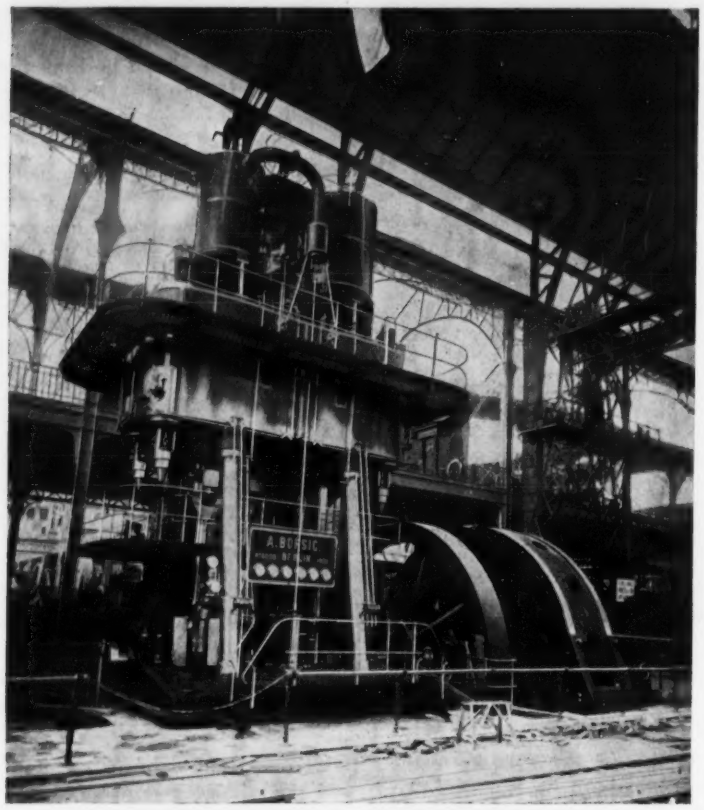


FIG. 11.—BORSIG-SIEMENS & HALSKE DIRECT-CONNECTED ENGINE AND DYNAMO, GERMAN SECTION.

tection of duct or planking, except at crossings where the traffic requires iron piping for them. There are a few aerial cables, such as those for direct current running around the façades of the buildings on the Champ de Mars. The current, if alternating, is delivered to the circuits through nine different lines, ending in transformer stations to which the secondary circuits are connected in turn, with all due provision for safety.

At this point a new set of contractors, so to speak, come into the work, and the distribution of electric lighting has been awarded to a number of concerns, each of which has a specific part of the Exposition in charge. The disposition is as follows:

COMPAGNIE ELECTRO-MÉCANIQUE, PARIS. Gardens of the Champs Elysees, 174 direct arcs, 10 amperes, 500-550 volts. Monumental Gate, 24 direct arcs, 12 to 15 amperes; 12 alternating arcs, 13 to 14 amperes, and 3116 incandescent lamps, alternating, of 5 candle-power. There are also some 10 and 16-cp lamps in the buildings around the Gate. Alexander Third Bridge, 508 incandescents, 16 candle-power, alternating.

COMPAGNIE ELECTRO-MÉCANIQUE, PARIS. Exposition banks of the Seine, Cours la Reine, open spaces, 51 arcs of 14 amperes on candelabras. Palace of Horticulture, 80 long-burning arcs of 500 watts. Alleyways, 10 arcs of 20 amperes. Riverside embankment, 35 arcs of 12 amperes. On the other, left, side of the river, Quai d'Orsay, 75 arcs of 14 amperes, and the embankment, 29 arcs of 12 amperes. The temporary foot bridges over the Invalides and the Alma Bridges, 50 incandescents of 16 candle-power. All the work in this batch is done with three-phase alternating current.

G. & A. MARTINE, OF LILLE. Quai de Billy and embankments of the right bank, 70 arcs of 12 amperes. Quai d'Orsay, 46 arcs of 14 amperes, and part of its embankment, 53 arcs of 12 amperes. Special bridge across the river between the Alma and Jena Bridges, 50 incandescents of 16 candle-power. Pont d'Jena, 12 arcs of 14 amperes on candelabras. Press Pavilion, 250 incandescents of 10 and 16 candle-power. All the work in this section also is done with three-phase alternating current.

ESTABLISSEMENTS CLEMANCON and the SOCIÉTÉ L'ECLAIRAGE ELECTRIQUE, PARIS. The Palace of Agriculture and Food. Grand nave, etc., 36 arcs, 20 amperes. Galleries, 245 arcs, 10 amperes. Salle des Fêtes, 4500 various incandescent lamps. Exterior façade, 400 incandescents of 5 candle-power. Candelabras, 1500 lamps of 5 to 10 candle-power. Coronas, and arches outlined, 2500 incandescents of 10 candle-power. Entrance aisles, 100 lamps of 10 candle-power. Passage from Electricity Building to the Salle des Fêtes, 34 arcs of 12 amperes. Machinery Hall, ground floor, 12 arcs of 12 amperes; basement, 12 long-burning arcs of 500 watts. Central portion of Electricity Building adjacent, 50 incandescents. All the work in this section, as above, is done with direct-current, three-wire, 235-235 volts. In addition, however, the same contractor has care of the entire lighting around the street side or outside faces of the palaces on the Champ de Mars, up to the Eiffel Tower, with 59 arcs, single-phase alternating current, 12 amperes, placed on candelabras or brackets.

G. & A. MARTINE, LILLE. Boiler room, Champ de Mars, 32 long-burning arcs of 500 watts suspended from the cross-beams. Ground floor, machinery halls, 76 arcs, 12 amperes. Parts adjacent to halls,

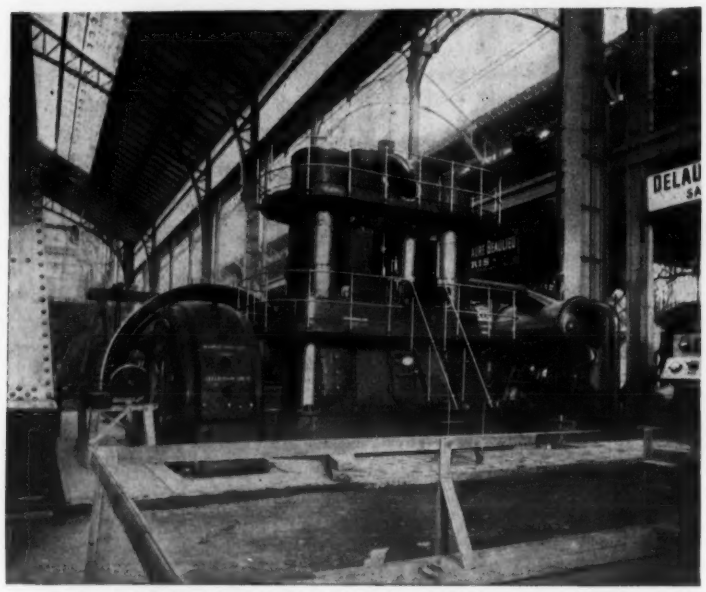


FIG. 12.—DIRECT-CONNECTED ENGINE AND DYNAMO, DELAUNAY-BELLEVILLE & CO., IN FRENCH POWER HOUSE.

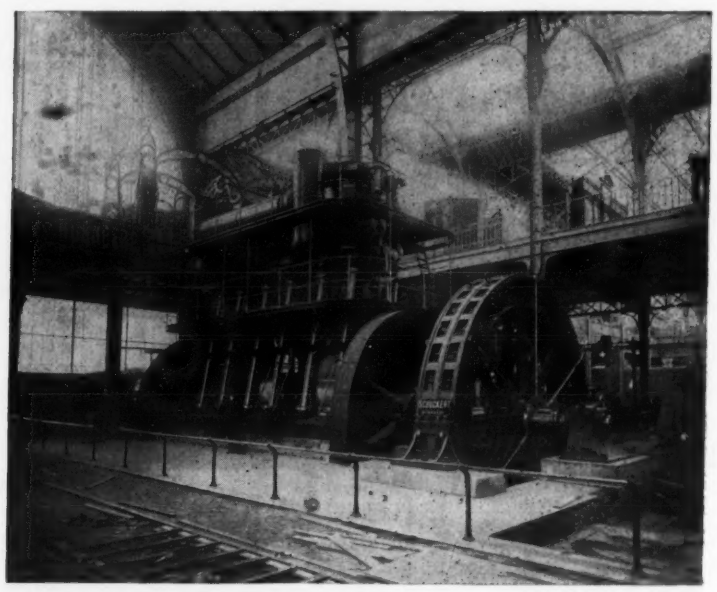


FIG. 13.—DIRECT-CONNECTED ENGINE AND DYNAMO OF NUREMBERG ENGINE COMPANY (SCHUCKERT), IN GERMAN SECTION.

31 arcs of 10 amperes on ground floor and 57 of same on the first floor, or gallery. Hexagonal space adjacent, cupola, 4 arcs of 20 amperes and 6 of same in basement; 3360 incandescent lamps in lines and bunches; and around Electricity Building, interiors, etc. Galleries and stairways of the Chateau d'Eau, ground floor, 163 arcs of 12 am-

peres, and 160 arcs of same capacity on first floor. Rapp Gallery, 57 arcs of 12 amperes. Desaix Gallery, 46 arcs of 12 amperes. The two distributing switchboards, 30 incandescents of 16 candle-power. All this work is done with direct current.

H. BEAU, PARIS. Salon d'Honneur of Electricity Building, on the first floor, twelve groups of 5 arcs of 12 amperes each; sixteen groups of 4 arcs of 12 amperes each. These lamps are massed in clusters as one group light, or centre of illumination. Luminous decoration of Electricity Building, 5000 incandescent lamps of 10 candle-power, 4 arcs of 15 amperes and 8 projectors. Chateau d'Eau and its immediate environment, 1100 incandescent lamps of 10 candle-power. All this work is done with direct current, three-wire, 235-235 volts, and includes a variety of special work.

G. & A. MARTINE, LILLE. Esplanade des Invalides, Palace of Varied Industries. Fabert, or foreign, side. Central aisle and Quai d'Orsay, 30 arcs on candelabras. Palace and annexes, 440 arcs of 14 to 20 amperes suspended from the beams or fastened to posts. Miscellaneous, 42 arcs, long-burning, of 500 watts. This work is done with three-phase current.

C. MILDÉ & CO., PARIS. Esplanade des Invalides, Palace of Varied Industries. Constantine, or French, side. Central aisle and Quai d'Orsay, 30 arcs on candelabras. Palace and annexes, 440 arcs of 14 to 20 amperes suspended from the beams or fastened to posts. Miscellaneous, 42 long-burning arcs of 500 watts. This work is done with three-phase alternating current.

If the lighting thus planned by the authorities for general "service" alone be summed up, it is found that over 21,000 electric lights are provided for general work. Upon the schedules given above, subject to the most recent changes, the arcs number over 3000, of which 2700 are ordinary arcs, 302, long-burning and enclosed, and 8, projectors. Of these arcs over 1400 are on direct current and about 1600 on alternating, 60 being on single-phase. There are now enumerated 18,748 incandescents, of which about 14,000 are upon direct current and 4000 upon three-phase. This gives a total of 21,749 lamps of all classes, and it is estimated that the number is more than doubled by the demands from the endless special exhibits, "concessions," restaurants, "side-shows," and other enterprises all requiring current in liberal quantities. But even after 50,000 lamps is reached, a large number must be added, to account for the individual work and lighting such as that of the Eiffel Tower, the Worthington pumping station, the United States Commission and other installations of the same character, such as the electric road, the moving sidewalk, etc. In short, the total number cannot now fall short of 75,000 lamps, and, as there is already a demand for more current from the outside sources, it would not be a surprising matter if the lighting ran up to well upon 100,000 lamps when the Exposition is at last in full swing a month or two hence. Certainly not until then will the full data be obtainable.

Great care has been taken to render the "service" lighting and the circuits and supply in general quite as trustworthy as though the plant were permanent. The various generating units all lead from their own boards to the main switchboards, and although assigned more or less to specific work in the various sections, can be interchanged if necessary, wherever the character of the current permits; while the main boards are also divided up for flexibility. The principal part of the direct-current network is three-wire, and the main conductors from the generating units of that category are grouped upon the three bus-bars of the board, which is divided in two so as to allow the work to be evenly distributed. There are ten circuits leading from the bus-bars. The list given above has noted the voltages and frequencies of the alternating service, and mention has been made in each section of the voltages at which current is taken from the secondaries; there being, as already noted, some nine separate networks or groups of alternate-current lighting. Practically speaking, the alternating-current generators are grouped in pairs or trios for their respective circuits, each being about equal to the load likely to come upon it for the present at least. The total capacity of the power plant being over 35,000 horse-power, it is not likely even upon the most sanguine estimate to be overtaxed, and there is incidentally with this arrangement, provision against the extinction of lights in any section due to the breakdown of a unit. Provision has been made by splitting the circuits and "staggering" the lines of the lamps to prevent any part from becoming dark should a circuit become cut out for any reason. In some instances, the current is taken off the high-tension alternating circuits by rotary transformers, of the Thomson-Houston, Alioth and Crocker-Wheeler types, converting two-phase and three-phase current into direct, or manipulating the direct current itself. Of the first class is the set for taking two-phase current at 2200 volts and delivering continuous current at 500-550 volts for motors driving apparatus at the Esplanade des Invalides. In the second class is the Crocker-Wheeler set stepping down the 500 volts to 115 for the Publishers' Building in the same section.

It will be seen that in a general way the Exposition authorities have provided most liberally for public lighting, and as this is supplemented in many cases by the exhibitors' own Commissioners—as in the case of the United States—there is no reason whatever for complaint on the score of lighting. A distribution or intensity of from one to two candles per square yard appears from the data available to be quite common, and the effects obtained are decidedly good so far as can be judged at this early stage when by no means all the circuits are in operation. Where exhibitors want special lighting, the price charged is on a basis of 2 cents per hectowatt-hour, or 20 cents per kilowatt-hour, below 800 hours, and above that 1 cent, but the 800 hours is figured apparently on that length of use shown of the meter with which every such installation must be accompanied. To quote the language of the regulations: "The number of hectowatt-hours corresponding to the capacity of the meter in hectowatts, multiplied by 800 hours, will be charged at 2 cents. All consumption above that at 1 cent the hectowatt-hour." There is, of course, a charge for all special, extra wiring done, as well as for the meters. At first, exhibitors were under the impression that the money for the meters was paid outright, but the fact is it will be refunded at the close of any contract period less any amount due for current, etc. The official charge for meters begins at $1 per hectowatt for a 20-hectowatt meter, the price decreasing as the size of meter increases. The charge for special current from the circuits for motive power is put at 1 cent per hectowatt-hour or 10 cents per kw-hour, but there is also a regulation which says that the administration will "put gratuitously at the disposal of exhibitors who make application in good time to the Director General, such current as they may need, provided it is required only for transformation into mechanical energy for driving the machinery or apparatus exhibited." The object of this would appear to be to encourage legitimate exhibitors to show processes but to tax properly the very numerous side-shows, but for whose existence the main mechanical exhibits could have found room on the grounds at the Champ de Mars, instead of being banished to Vincennes. So far as can be at present ascertained, some 450 power motors will be in use for driving machinery, in some 42 different classes, all on direct-current circuits. In all work for lighting and power, the exhibitor's expense begins at the moment he makes a branch from or a connection into the main circuits.

There are very elaborate rules governing the use of the current and the application of motive power, as noted briefly not long ago in these pages in the issue of May 5. The service plant is required to be in operation from April 15 to Nov. 5, or 205 days, although it will be well understood from what has been said in regard to the general incompleteness, that the first date has not been adhered to, although many units are already in full working order. The number of hours or the special work required of each unit is a matter of daily schedule. The engines are supposed to be in shape to start up every morning at 10 o'clock, and the general movement of things is naturally governed by the operation of the pumping plant, which runs from 9:30 a. m. to 12, from 1:30 p.m. to 5:30, and from dark until the closing hour or till the needs of regular and special illumination have been met. The schedule as to the parts of the Exposition to be open at night is not in any wise definite, beyond the fact that the Champ de Mars with its fine operating plant will be open. The proprietors of the side-shows are all keen for a "wide open" show until midnight at least, but the management has thus far exacted two tickets of admission for entering the grounds after 6 p. m., instead of the one ticket only required for entrance from 10 a. m. up to that time.

Outside of the necessity of conforming to the voltage and nature of current obtainable in any section, there is no general uniformity in the lamps used. On the contrary, a wide range of shape and size is to be seen as well as of method of suspension for the arcs. The preference has naturally been given to ground glass, or opal, globes, so far as they have yet gone into operation. There are some pretty cluster lights on the new Alexander Bridge, but that is a permanent structure of which they are an equally permanent part. The single lamp-posts there, as on the Pont d'Jena, which is also now a part of the show, are quite ordinary. Outside the Electricity Building front and the Chateau d'Eau, there are some handsome lamps, and within the former, in the long gallery known as the Salon d'Honneur, there are

some unusual suspension groups of 4 and 5 arcs, hung by ropes from the four arms of wooden cross-bars. The outsides of buildings, in the long arcades on the ground floors, where restaurants chiefly occupy the broad spaces, are lined with arcs hung from the ceilings, but the façades are in general bare of incandescent lamps. At Chicago, in 1893, it may be remembered, for the buildings and water edges around the great Court of Honor, a beautiful use was made of incandescents to accentuate their outlines, and to such an extent was this carried that at the Palace of Fine Arts alone nearly 18,000 lamps were concentrated, of which a large proportion were entirely decorative in the way mentioned. Putting aside the magnificent Chateau d'Eau, one sees at Paris no such daring or startling piece of work as was carried out by Mr. Stieringer in the vast Manufacturers' Building, where the main aisle lighting was done by five coronas, one of which had a diameter of 75 ft., and all of which carried a total of 414 arcs at a height of 140 ft. from the ground; the whole interior requiring 1700 arcs of 3000 candle-power each. One misses also such lighting effects as the famous Edison Tower in Electricity Building at Chicago, 90 ft. in height, carrying 6000 incandescents of 40,000 candle-power and having at its peak a lamp built up out of 30,000 pieces of crystal. This shaft is, however, rivaled in some degree by the two wierd and striking obelisks flanking the monumental entrance gate on the Place de la Concorde, which are studded all over with incandescents in colored bull's-eyes, etc., and have arc lamps at the top. Returning to exterior or façade illumination, it may be said that preparation has been made for the free use of gas jets, the runs of piping for which can be detected around many of the cornices.

While the service figures given will include much of the lighting to be enjoyed by American spaces and exhibitors, the special lighting put in by the United States Commission is quite extensive, and has already been briefly noted in previous articles, but should be mentioned here in its place. In Electricity Building, the United States Director of Machinery and Electricity, Mr. F. E. Drake, has been setting some 25 or 30 handsome posts to carry each two Western Electric enclosed arcs, this lighting being special to illuminate and help define the American section from those of other countries. In the Salon d'Honneur above, Mr. J. S. Anthony, Assistant Director, has put about 20 Toerring enclosed arcs, and some 500 ground glass General Electric incandescents to outline the crests of the beautiful white façade. Within the Court, holophane globes are used to throw the light down on the exhibits. Not so very far away, the American exhibit in mining, etc., has about 500 lamps, while over on the Esplanade des Invalides, the greatly admired façade of the American section in the Building of Varied Industries, has with its interior aisles, no fewer than 3000 frosted incandescents. Indeed, a summary glance at this stage would indicate that the American exhibits will be notable if only for the amount of illumination in which they bask, a wise provision and one which may also help convey to the European eye what an American means when he says that a place is well lighted.

Of the generating plant, details must be reserved until it is at least in fuller working order, for at this moment the bare, untouched foundations of some units are still to be seen, and it was not indeed until the first week in May that the cheering sight was seen of smoke issuing from both of the big chimneys at once. It will have been noticed that the largest unit is of a capacity around 2500 kilowatts, and it may be added that in general the foreign units run larger than those in the French section. Details as to the relative units and their capacities have been given in the table herewith. The biggest group, that of the Siemens-Halske generator with Borsig engine giving 3000 horse-power at 85 r. p. m., has a stationary armature with a revolving field inside. In the French group of machines, many of the engines are of the single-cylinder type, reducing the normal steam pressure of 140 lbs., and in one horizontal unit, that of Weyher & Richemond, the single cylinder cares for the total capacity of 1000 horse-power. The French Thomson-Houston Company has a fine three-phase unit of 1200 horse-power driven by a vertical Cail engine of the familiar E. P. Allis type.

The work on the steam plant has been in the hands of Prof. Ch. Bourdon, of the Central School, well known as the mechanical and electrical engineer of the Exposition of 1889. With him as assistant has been associated M. Gabriel Eude, and the principal engineer of the hydraulic plant has been M. Meunier. The electrical engineer is Mr. R. V. Picou. We are greatly indebted to these gentlemen for much of the data given herewith. Their work, it may be said, has been most wearing, owing to the backwardness of the buildings, so that they could not get possession for purposes of installation; while now after a long period of intense strain, their real labors of supervising so large an installation have but just begun.

EXPOSITION NOTES.

MR. J. H. MCGRAW has been in Paris during the first week of May to inspect the Exposition and the exhibit of the McGraw Publishing Company and its publications, as well as to see the mechanical and transportation features at Vincennes. Although the show is generally still in a most backward state, he has found much that is of interest.

E. U. American exhibitors are not yet happy by any means as to the delivery of their goods, and one can see them daily on the hunt all over the Champ de Mars or down at Batignolles; or hear of their going off to Havre to shake up things there. The express delivery system may be said to have gone utterly to pieces, and people have to dig themselves out. Director General Drake was noticeable this week out on the Champ trying hard to get one car with dynamos, etc., under cover before the rain came on to spoil it. When deliveries began, many American exhibitors went straight for every case bearing "E. U." But they soon found out that that stood for Exposition Universelle, and not for the French for United States—Etats Unis. One American exhibitor in the electrical section after hustling by sheer force of will some 250 cases to his space found he had room for the contents of 50, and his deep problem, under all the conditions of rules, customs duty, octroi, packing cases, expressage, etc., is to determine what he will do next.

ACCIDENTS. There have been minor accidents in Electricity Building and the steam plant, but fortunately the whole of that great exhibit has been put in with very little serious disaster. The past week has, however, witnessed two fatalities due to the general incompleteness, and the wonder is there have not been more. By the breaking down of a foot bridge built of wired cement, eight persons were killed on April 28, and several injured. Next day, four men fell from a scaffolding in the Salle des Fêtes portion of old Machinery Hall, and were killed. These things naturally cast a gloom over the Exposition for a time, and made the public nervous. As a matter of fact, the authorities have been very careful and thoughtful in their inspection and arrangements for safety, but where so much work remains to be done, there will be attendant danger. The "wired cement," by the way, was to form part of the foundation, it is said, of the American National Building among others, but the material was not approved, and the walls were put up on other foundation around it. The material would seem to be all right when properly made and properly used.

SUPPLY OF CURRENT. The great question which has been agitating the minds of many exhibitors is the supply of current. Up to the close of April and into the first part of May, the service plant was not available. It is true steam was on, and some of the units, notably the German, were ready to run, but the engineers in charge of these units were afraid to start up with so much dust and grit around the machinery and with tracks delivering goods right and left of them. The section particularly affected by the lack of current appears to be the Trocadero region, where there are a number of special concessions requiring it for light and power. The exhibitors have paid, it is said, about $20 per square yard for their space, and have wired up, in addition to all other expenses, which are running along without any income per contra. On trying to get current from outside the grounds, they discover to their disgust that only single-phase alternating is available; while they all have regulation three-phase converters. The air is full of threats and complaints from these unhappy people, who have been doing their best to make life a burden to poor Mr. Picou, the electrical engineer in chief.

VINCENNES has so far remained practically inaccessible to the great bulk of Exposition visitors. Six miles away, it could be reached by cab, by boat, by the belt steam railroad, or by street car, including the Thomson-Houston trolley system that starts from the Bastile Column. Any one of these routes has meant over an hour. The boat trip has been pleasantest, but at its end was a dusty climb up a hill into the grounds. It is now stated, however, that the new Thomson-Houston road will be running from the river up around the Exposition there during the second week of May. It will be a great boon, while exhibitors may then possibly derive some return for their trouble and expense. The last Sunday in April, while the main Exposition was visited by 250,000 people, there were only 10,000 at Vincennes, and even at the best the proportion is likely to stand that way except during the automobile races, which will draw big crowds out to the leafy, pretty woods there. Meantime, the new American trolley road will be an immense alleviation of a situation which had become well-nigh intolerable.

AMERICAN OPENING. Sousa's Band having now arrived, the American National Building on the Street of Nations is to be opened. It was at first intended to have a general American opening on May 10, but the present plan is now to open the Pavilion on May 12, and to postpone the formal opening at Vincennes until about May 14. Backward as it may seem to the casual observer, the special American Machinery Building there is by far the most advanced, except perhaps Transportation, which is merely a set of tracks with a fine train-shed roof, the tracks now being loaded with steam and electric locomotives, railroad cars, trolley cars, underground railway cars, etc. A visit to Vincennes on May 3 revealed a state of affairs outside the American Building that it would seem possible only to deal with in six or seven months at the present rate of progress, but which may improve if more men are thrown on the work. Some buildings are just platted out; others have their steel framework partly up; others have walls but no roof, and some that are finished have no floor down, while those with floor are bare of exhibits. In the American Building many exhibits have been complete for weeks, and all of them are well along where the goods have been delivered. This is the more creditable when it is remembered that many of the exhibitors also have spaces up on the Champ de Mars in Electricity, Machinery, etc., and thus have to oscillate, so to speak, from one end of Paris to the other to do their work.

Electrical Conductors and Dirt.*

BY A. A. CAMPBELL SWINTON.

EVERYONE must have noticed how electrical wires and fittings gather dust. Hot-water pipes have a similar tendency, and for a long time I was of the opinion that the action was similar in both cases, and was due to air currents produced by heat Recently, however, I have had reason to alter my views, and the matter appears to be of sufficient interest for detailed description.

In a new office I have now occupied for five months there are in my own room five plain pendant fittings. As the ceiling is of concrete, and as it was necessary not to disturb the tenant above, these pendants all consist of plain flexible cords of the usual twisted pattern, which start from ceiling roses on the wall near the cornice and are led through insulated eyes across the ceiling to the points from which they hang. The supply is the continuous-current supply of the Westminster Company at 200 volts. Three of the pendants are upon one switch, the two others being upon another switch. Of the set of three, two are of 16 candle-power and one of 32 candle-power. I mention this latter fact, although it has nothing to do with the phenomenon observed. All the lights are in practice used at once, so that in this respect the conditions are the same in each case. The following, however, are the results, which are sufficiently remarkable to deserve notice.

Within a week or two of my entering into occupation of the office and using the lights it was observed that, whereas the three flexible cords connected with one switch remained clean, the two cords on the other switch were rapidly accumulating dust. The latter were repeatedly dusted, but the effect always repeated itself. At present after some five months use, while the one set of three cords are still comparatively clean, never having been dusted, the other set of two cords are thickly covered with an aggregate of dust particles, which in some places project fully one-quarter of an inch from the cord. Further, while the plaster of the ceiling in the case of the set of three cords is absolutely white, and the ceiling roses at the ends of these cords retain their original color, the ceiling immediately above the set of two cords is blackened with a well-defined broad dark line while the ceiling roses that serve these two cords are also covered all over with a dark deposit.

Now for the reason of this strange phenomenon. It is very simple. In the case of the set of three pendants, the flexible cords and ceiling roses of which do not become dirty, the switch is in the positive pole In the case of the other set of pendants, whose cords and roses become covered with dust, and which even blacken the ceiling with which they are not in contact, the switch is in the negative pole. Now, as is well known, the negative conductor in the street mains has a tendency to earth itself to an extent which is sufficient to cause the negative lead to be always almost at the same potential as earth. Consequently the positive conductor is always at nearly 200 volts potential above that of earth, and therefore above that of the dust particles present in the atmosphere. This point has been tested in my office with a voltmeter, with the results that from the negative there are only about 30 volts to earth, while from the positive there are 170 volts to earth. The reason for the effects observed is thus obvious. In the case of the three pendants, whose switch is in the positive, it is only when the switch is turned on a few hours per diem out of the 24 that there is any appreciable difference of potential between the cord and the surroundings. Even then it is only one conductor in the cord that has this potential, and the exterior of the covering very possibly always retains zero potential. In the case of the other set of two lamps, whose switch is in the negative, the result is far different. When the switch of this set is turned on, no doubt the conditions are similar to the other set when the latter's switch is also turned on. But during the many hours every day when the switch is turned off, in the case of the two-light set, both of the conductors remain constantly at a potential 170 volts above that of its vicinity. The dust is therefore caused to deposit upon the cord and upon the ceiling rose by electrostatic attraction. No doubt the use of 200 volts, which will give four times the attraction afforded by 100 volts, has made the effect more marked in this particular case.

I should not have thought it worth while bringing the above facts forward publicly had they not been so marked as to be a serious nuisance in the case of the pendants whose switch is in the negative. From the point of view of the wiring of decorated rooms in a town with an atmosphere like London, the matter is of very considerable importance. It will be found that with the switches in the negative, an amount of dirt will be deposited in a few weeks that would take years to accumulate with the switch in the positive. I am well aware that from a totally different point of view, in damp situations, there is an advantage in putting the switch in the negative, for the reason that otherwise the metallic mechanism of the switch is liable to be corroded away by electrolytic action. In dry places, however, where it is desired to keep electrical wires and fittings clean, I have no doubt that in an atmosphere such as we have in this great city, switches should always be placed in the positive conductor, so that the exteriors of such fittings and wires should remain as far as possible at earth potential.

*London *Electrician*, April 27, 1900.

Ohio Independent Telephone Association.

About 100 of the 227 independent telephone companies in Ohio were represented at the first annual meeting of the managers of the companies in the Ohio Independent Telephone Association, held in Cleveland, Wednesday and Thursday, May 9 and 10. The meeting was held in the Electric Building, the new headquarters of the United States Telephone Company and the Cuyahoga Telephone Company, the latter being the independent company in Cleveland which has recently commenced operations. The object of the meeting was to discuss and become familiar with the best methods to be pursued in conducting long-distance business and other matters of general interest to the independent movement were also discussed.

Mr. Maxime Reber, general manager and mechanical engineer of the United States Company, addressed the conference at the Wednesday morning session, setting forth the objects of the long-distance company, explaining the methods of construction and operation and giving ideas as the best methods to be used in securing quick and satisfactory long-distance service. He expressed the opinion that the highest possible efficiency through local service could only be obtained by standardizing apparatus and systems. The remainder of the session was devoted to a discussion of the various systems in use by the different State companies. It was decided to push the work of standardizing equipments as rapidly as consistent and a committee was appointed to draw up specifications for standard apparatus, a report to be made at the national convention of independent telephone companies, to be held in Cleveland next month. The committee on standardizing equipment is as follows: Mr. Maxime Reber, United States Telephone Company, Cleveland, chairman; Mr. S. M. Strong, Ashtabula Telephone Company; Mr. A. H. Rentenger, Home Telephone Company, Chillicothe; Mr. M. M. Herron, Millersburg Telephone Company, and Mr. George H. Metheany, Lima Telephone Company. The opinion was expressed that the common battery system is the most satisfactory, and that within the next two or three years it will be universally adopted by all the companies in the State.

Wednesday afternoon was devoted to an inspection of the United States and Cuyahoga exchanges, during which a thorough explana-

tion was given of the long-distance boards which have recently been completed.

Mr. H. C. Critchfield, secretary of the Ohio Association, was chairman of the Thursday session, and a greater portion of the morning was spent in discussions for the betterment of conditions existing in the local exchanges. The conditions which seem to demand competition with the Bell interests in the question of cheap local 'phones were discussed from all standpoints, and it was the consensus of opinion that no profit was to be derived from cheap party lines such as are being furnished in nearly all the small towns throughout the State by the Bell companies. Mr. Critchfield expressed the opinion that the 50-cents-a-month 'phone simply served as an educator to the public, since it was impossible to secure satisfactory service on the party lines; yet the cheap 'phones accustomed people to using the telephone. He said that there are two classes of people who patronize the cheap party lines—the irresponsible class of people who generally use the 'phones for a few months and then decline to pay for them, and an honest class of people who feel that they cannot afford to pay the higher rates. The former class are not wanted by any one; merchants do not care to be connected with them because they generally use their telephone in ordering goods, often avoiding payment in this way. He expressed the opinion that the cream of the poorer class of people mentioned would pay $1 per month or more for satisfactory service. Representatives of several companies stated that at various times their stockholders had discussed the advisability of meeting the cheap rates, but the change had been invariably voted down, and with satisfactory results.

Mr. C. C. Curtis, of the Sandusky Telephone Company, gave his experience with the competition of cheap rates. He stated that the conditions existing in Sandusky were probably different from those in any other city in the State. Recently over $125,000 has been expended in improvements on the independent system, and it has been thoroughly overhauled and rebuilt, so that the service is now equal to the best. The rates at first announced, $2.50 and $1.50, have been strictly adhered to, with the result that during the past year the company has paid excellent dividends and has made a gain of 1.19 telephones per day.

A manager from the southern part of the State said that his company had yielded to the demands of a few of the residents for party line telephones. It seemed that in this town the society, business and politics were dominated by two rival bankers. The company put the two bankers on the same party line and in a few days there was an upheaval which startled the entire community. Since then nothing has been heard about party line 'phones, and the few which were installed were ordered taken out.

The questions of directories and advertising were discussed. Several managers stated that they had given out contracts for their directories to advertising agencies, thus securing them free, advertisements being placed on alternate pages. It was the general sentiment that this was a mistaken economy since it invariably antagonized the local newspapers, besides giving the company a cheap standing in the community. A plain card or booklet was found to have been the most satisfactory directory. As to newspaper advertising, it was the general sentiment that an occasional paid write-up setting forth the advantages of the independent telephones, with especial pointers regarding the disadvantages of party lines, was preferable to display advertising. It was agreed that a liberal patronage of the local papers is money well spent, since the papers frequently dominate public opinion.

The question of giving satisfactory service at reasonable figures to the farming communities is becoming more and more a problem, and this subject brought forth considerable discussion. It was agreed that even though the farmers' lines were occasionally unprofitable investments in themselves, yet the farmers are rapidly being educated into the advantages of long-distance connection, and lines of this variety are proving excellent feeders for the toll lines. They are also of great assistance in building up the local exchanges, giving local people a larger number of connections and better service than they formerly received. It has been found by a number of managers of local exchanges that a rule of 20 per cent profit should be followed in making farmers' connection; viz., 8 per cent for depreciation of values, 6 per cent for operation and 6 per cent on the investment. A number of figures on the cost of constructing farmers' lines were given, and it was the general experience that except in a few cases service could not be given for $1 per month.

Manager E. J. House, of the Painesville Telephone Company, stated that he had constructed several farmers' lines within a reasonable distance from town with 10 'phones on a circuit at a cost of $600, and on a five years' contract he furnished $1 telephones. In this case the farmers secured their own right of way and brought in the contracts. Where a farmer lives away from the main line, he erects his own poles, which become the property of the company. Mr. House stated that farmers' lines could not be erected under $100 per mile.

The Warren & Jefferson Telephone Company, operating in Trumbull and Ashtabula Counties, has probably the most complete farmers' service in the State. It operates 800 miles of wire in the farmers' districts and has 375 subscribers among this class. The lines are built with the best full metallic equipment and cost $135 to the mile. Not more than six telephones are placed on one line and the company will not put up a line more than five miles away from its exchanges unless more than one subscriber is secured for that line. The company makes a uniform rate of $1.25 per month, which entitles the farmer to talk to any one within his county, including the local exchanges at Warren, Niles and Jefferson. For $1.50 per month the farmer is allowed connection in both counties mentioned. The subscribers of the local exchanges are obliged to pay toll in talking with the farmers, however.

Judge J. M. Thomas, who is a leading official in the Independent Telephone Association of the United States, gave an outline of the plans for the meeting of the Association to be held in Cleveland next month. The association includes a larger portion of the independent companies of the country, and is represented in 21 States. The Ohio companies not yet members were strongly urged to join. The delegates to the conference next month are to be the guests of the Ohio Association. In addition to the meeting there will be an exhibition in the Electric Building of telephone apparatus and material of all kinds, and it was stated that a large number of applications for space had already been received. The number of exhibitors from the East will be unusually large.

After the adjournnment of the meeting the delegates were given a luncheon by the Cuyahoga Telephone Company, after which a number of them visited the factories of the North Electric Company and the Williams-Abbott Electric Company, manufacturers of telephones.

The first directory of the United States Telephone Company giving rates to about 1000 toll stations of the company now in operation, will be sent to all the independent companies in Ohio in the near future.

CURRENT NEWS AND NOTES.

EXPERTS AND EXPERT EVIDENCE.—At the meeting of the American Institute of Electrical Engineers on May 15, Mr. J. Hindon Hyde, a member of the New York Bar, presented a paper entitled "Experts and Expert Evidence."

FARADAY ELECTRICAL SOCIETY.—Prof. F. B. Crocker will deliver a lecture on Thursday evening, May 24, before the Faraday Scientific Society, East Broadway and Jefferson Street, New York, in "Electrical Development in the Far East."

CANADIAN ELECTRICAL ASSOCIATION.—Owing to the recent disaster at Ottawa, the place of meeting of the next convention of the Canadian Electrical Association, cannot be held in that city, as intended. Announcement will soon be made as to the meeting place.

PROF. GEO. F. SEVER, of Columbia University, has accepted the position of superintendent of electrical exhibits of the Pan-American Exposition. Mr. Sever will have charge of the collection of electrical exhibits, and in particular, the collective exhibits. The aim of the exposition is to secure only such exhibits as may be new, novel or of especial interest.

AMERICAN GENERATORS IN JAPAN.—At the Kyoto (Japan) Water Power Office it was expected some weeks ago that the two generators built for that company by the General Electric Company would arrive about May 20. When these machines are installed it will be possible to furnish 2000 horse-power day and night instead of 1600 horse-power in day time only, as at present.

TROLLEY CONTACT SPRING CASE.—The United States Circuit Court of the First Circuit and District of Massachusetts has granted a perpetual injunction enjoining the infringement of the eighth claim of the Anderson trolley patent (issued Oct. 1, 1899). This claim is on the combination, with a trolley-frame and trolley-wheel, of metallic conducting-brushes between the hubs of the trolley-wheel and the said frame.

A. I. E. E. ELECTION.—The canvass of votes at the annual meeting of the American Institute of Engineers, May 16, showed the election of Mr. Carl Hering as president, Mr. Hering receiving 381 votes and Dr. Pupin 179. The other regular nominees received about 600 votes each, except Dr. Hutchinson, whose vote for manager was in the neighborhood of 350. The official canvass of the votes was not completed at the meeting, with the exception of that for president.

STORAGE BATTERY PATENTS.—A patent issued May 8 to Luis Gumiel Garcia, of Aspe, Spain, describes a storage battery electrode, consisting of a bar having perforations, some of which run in one direction and others in another direction but in parallel planes, with openings forming communications between the sets of perforations. To form a complete electrode, these bars are arranged vertically and parallel to each other, being separated by small ebonite rods. A patent issued the same day to E. A. Sperry, relates to an envelope for elements of a storage battery consisting of an agglomeration of pyroxylin fibre and cellulose fibre in sheet form, having one or more surfaces ribbed.

ELECTROLYTIC INTERRUPTER.—A patent issued May 8 to Prof. Elihu Thomson, describes a form of Wehnelt interrupter. The construction consists of a hard rubber tube through which extends a copper rod or wire terminated by a platinum tip which protrudes through a closely-fitting opening in the end of the tube. A lead or other metal tube constitutes the cathode and surrounds the outside of the rubber-supporting tube, the lower edge being in proximity to the platinum anode. The upper end of the insulating supporting tube is threaded, whereby the copper rod and with it the platinum anode may be shifted in the supporting tube to permit the extent of the exposure of the tip in the electrolyte to be varied. The immersion of the outer tube in the electrolyte may also be varied.

LIGHTNING ARRESTER.—It has been found in practice that after a considerable period of service a short circuit is sometimes established between the sparking terminals of a lightning arrester. In a patent issued May 8, A. J. Wurts states that he has found by experiment that if an equal resistance be interposed in the circuit of each of a plurality of spark-gaps, the discharge will invariably subdivide between the several gaps, thus dividing the intensity of the entire discharge by the number of paths. The construction described to fulfil this condition is as follows: Resistance is interposed in the circuit in the form of cylindrical rods consisting of a mixture of graphite, kaolin and some binding material, such as starch. These resistance rods have one end joined to a circuit terminal, and their other end respectively connected to the outer ends of terminal strips, the latter being separated from a terminal plate by a spark-gap.

CATHODE RAY LAMPS.—A patent granted May 8 to C. H. Stearn and C. F. Topham, of London, England, describes a lamp for giving light by the action of cathode rays on an anti-cathode. The principal object of the patent is to provide means for regulating the vacuum. The exhausted globe has a small auxiliary communicating chamber containing chlorate of potash or an ammonium salt. When an electric spark is passed through the substance, a gas is formed which passes into the main chamber, thus lowering its vacuum. This action is made automatic by means of an electromagnet which, when the vacuum becomes abnormal, operates to work an interrupter in a circuit containing in series a condenser and the spark-gap within the auxiliary chamber. As soon as sufficient gas has been produced to lower the vacuum, the interrupter ceases to automatically operate, its action depending upon the increased discharge resistance due to a vacuum higher than normal.

MEETING OF FIRE UNDERWRITERS.—The thirty-fourth annual meeting of the National Board of Fire Underwriters was held in New York on May 10. In his address, President Irwin laid emphasis on the "enormous fire loss of the country, which amounted in 1899 to $153,597,830—the greatest since 1893, and, excepting that year, the greatest since the Chronicle Fire Tables were begun in 1875." In regard to electric and other installations, the Committee on Lighting and Heating in its report said in part: "When it is considered that electricity is a cause of fire operating for the most part out of sight, behind walls and under floors, and that the evidence of it, like the evidence of an incendiary, is often destroyed by the fire, so that the probability is that the danger has been underestimated rather than magnified, your committee believes that the subject should have your careful consideration." The election of officers for the coming year resulted as follows: President, George P. Sheldon, New York; vice-president E. Ellison, Philadelphia; secretary, Robert B. Heath, Philadelphia; treasurer, Fred W. Arnold, Providence.

ELECTRICAL INTERESTS IN THE OTTAWA FIRE.—The electrical interests of Ottawa suffered severely in the late Hull-Ottawa fire calamity. The Ottawa Street Railway Company, however, suffered least in proportion by reason of its fine new fireproof power house, just completed, having fulfilled expectations as to its ability to withstand the intensity of the flames and heat which for two hours raged over it. The roof, however, was not built on an absolutely fireproof plan, being constructed of corrugated iron laid over wooden rafters. This roof melted and was consumed, the blazing mass falling upon the 2000-hp generator, but without injury to it or to any portion of the electrical plant. This new power house is operated by water. The old power house, which was hereafter to be an auxiliary, having a capacity of 2200 horse-power and operated by steam, was completely destroyed, entailing a loss to the company of about $125,000. The Ottawa Electric Light Company had three of its stations burned at the Chaudiere and in Hull. The loss occasioned this company is estimated at about $100,000. Ottawa was practically left in darkness for several days

PRIMARY BATTERIES.—Three patents on primary batteries were issued May 8, one to V. J. Busson, of Paris, France, and two to C. M. Platt, of Waterbury, Conn. The essential feature of the Busson invention consists in the composition of the negative electrode of a sal-ammoniac battery, which is formed of an agglomerate of one or more metallic oxides and carbon or plumbago, which substances are pulverized and mixed together with a solution of the sulphate of the metal to be used as the soluble electrode. The agglomerate is enclosed in a porous envelope or casing not attacked by the battery. In the usual form of sal-ammoniac battery oxychloride of zinc is formed which gradually cements and hardens the depolarizing compound. By the use of the sulphate solution to moisten the agglomerate, this defect is obviated. The Platt patents relate to means for supporting the zinc element of a cell. In one case the holder consists of a band with supporting posts resting on the bottom of the jar, continuations of the posts above the band supporting the zinc. In another case, the support is made of wire formed into a ring resting on the bottom of the jar with three twisted vertical posts to support the zinc. In still another case a band supports porcelain posts on which the zinc rests.

MAGNETIC BLOW-OUT PATENT SUIT.—Judge Wheeler, of the United States Circuit Court of the Southern District of New York, handed down an opinion sustaining the Thomson magnetic blow-out patent, No. 401,085, dated April 9, 1889. The suit was brought on two patents, one of which was for a magnetic field in an electric switch to dissipate the arc formed by breaking the circuit, and the other for a shield of insulating material to control the place of formation of the arc. Judge Wheeler held that the first-mentioned patent had been declared invalid by a previous decision, and confined attention to the second patent, which he sustained. Referring to a claim of invalidity owing to priority of invention, he said that only one of the citations used an insulating device as a guard, but that the safety device of this patent (W. L. Stevens, April 11, 1885) does not appear to be any arc-dispelling device of a circuit breaker for constant use, but to be a device for suppressing the formation of an arc under the occasional and extraordinary circumstances of electrical storms, to guard against danger from lightning. In the opinion of the court it has not any combination with a circuit breaker and a magnetic field for dispelling an arc are formed by continual breaking of the circuit in the operation of powerful electric machines; and the addition of an insulating shield to the prior combination of the magnet with a circuit breaker seems to be new and highly useful, and patentable whether the combination of the magnet with still prior machines was patentable or not. "These claims are for this addition

of the shield to the combination of a magnet with a circuit breaker, thus forming a new and useful combination, which was patentable as such." The court concluded that in this view of the invention the infringement of them by the defendant appears to be made out. Notice was given of appeal against the decision.

FREQUENCY INDICATOR.—If resistance, inductance and capacity are associated in a circuit, the relations existing between the several e. m. fs. set up in them will vary with the frequency. In two patents issued May 8 to Mr. Charles P. Steinmetz, this principle is employed for the operation of a frequency indicator. Two coils, *A* and *B*, in series and having their planes at an angle, are connected to the line; in their common field is a disk or cylinder of conducting material movable about its axis and carrying an indicating pointer. In shunt with one of the coils, *A*, are an inductance coil and condenser in series. The relative values of the resistance, inductance and capacity of the coil *A* and its shunt circuit are so chosen that at a given frequency the currents in the coils *A* and *B* are in phase with each other, and consequently no turning effect is produced on the disk within their field. At any other frequency, however, the currents in the two coils are necessarily out of phase, a rotary field is thereby produced and the disk tends to turn. A coiled spring prevents such rotation, but allows the disk and its indicator to take a position corresponding to the change of frequency. The patents describe a number of variations of the particular form of indicator above described. A third patent applies the principle above outlined to a motive device which may be applied to govern an engine driving an alternator. In this case the disk is permitted to rotate upon change of frequency. At frequencies above the normal it will rotate in one direction, and in the opposite direction at a frequency below the normal, and this motion may be utilized in regulating the speed of prime motors driving alternators, or for the speed regulation of any type of apparatus. For example, the motive device may be geared to a governor, the valve of an engine, the admission gate of a water wheel, the rheostat of a motor, etc.

LETTER TO THE EDITORS.

Transformer Magnetic Leakage.

To the Editors of Electrical World and Engineer.

Sirs:—In your editorial in the issue of May 5 on "Inductive e. m. fs. of Transformers," you briefly sum up the generally accepted idea of the baneful influence of magnetic leakage on the secondary voltage of transformers when, after speaking of resistance drop, you mention that "The other source of drop in a transformer is that due to magnetic leakage and is apt to show itself in a marked manner when the transformer is loaded inductively. This source of drop is due entirely to the fact that the magnetic fluxes of the two coils exhibit a selective behavior and do not link so freely and fully with the primary and secondary windings as they should."

I have reason to believe that the influence of magnetic leakage is not nearly so great as it is generally held to be, and, in fact, that its effect on drop is comparatively small, and beg to call your attention to my reasons based on experiments published in the *Electrical World* of March 27, 1897.

They included what I believe to be direct and positive measurements of the number of lines of force interlinked with the primary and the secondary coils of transformers, obtained by the simple expedient of winding a fine wire alongside of the primary and secondary wires. Each exploring coil thus formed was composed of the same number of turns as the secondary winding itself and had its ends brought out separately. The voltage of these exploring coils then indicated the number of lines of force interlinked with the primary and secondary, while the difference between their voltages measured the difference between the lines cutting primary and secondary—in other words—the magnetic leakage.

In one transformer, especially constructed in a ring form with a uniformly distributed winding of both primary and secondary, interspaced so as to avoid great magnetic difference of potential, the total drop of potential in the secondary from no load to full load was 2.37 volts, while the difference of voltage between exploring coils, and therefore drop due to leakage was, at full load, about .15 volt, or 6½ per cent of the entire drop.

In a commercial shell-type transformer, by direct measurement in the same manner, only one volt drop out of a total of 18.3 volts at maximum load were caused by magnetic flux originally passing through the secondary failing to traverse it at overload, demonstrating that under ordinary conditions magnetic leakage has a comparatively small effect on secondary drop with non-inductive loads.

The chief reasons for the fall of potential are found in two conditions, one of which is the resistance of primary and secondary and its increase with heat. The other may best be understood by inquiring what it is that permits the primary coil to pass more current at full load than it does at no load. Its resistance is constant or increasing with heat. The voltage impressed upon it is constant. To pass more current the counter e. m. f. (or self-induction) generated in it must either vary in phase with the respect to the impressed e. m. f., giving their resultant a greater value; or, the phase relation remaining unaltered, the counter e. m. f. must decrease. This counter e. m. f. was, of course, found at the terminals of the exploring coil wound in with the primary.

The tests showed little or no phase shifting of counter e. m. f. with respect to impressed e. m. f., a fact borne out by the small displacement of even the secondary e. m. f., which was proven to be due to the leakage; but the experiments in this direction are not sufficiently complete to be conclusive. It may be assumed as very small.

It was, however, readily observed that the voltage of the exploring coil in the primary *fell off with load*, showing that less magnetic lines were cutting the primary than had been interlinked with it at no load. In other words, the magnetization of the core lessened with load and, of course, the secondary voltage correspondingly decreased. This fact is substantiated by lessened core loss at full load, etc., which need not be discussed here.

If the phase of the counter e. m. f. of self-induction does not vary at all with respect to the impressed e. m. f., the primary of a transformer cannot pass more than its no load current until the magnetic flux through it grows less, reducing the counter e. m. f., and as a consequence the secondary e. m. f. In fact, I consider the drop of secondary voltage on non-inductive circuits as essential an accompaniment of the operation of a transformer on constant-pressure mains, as is the slowing down of a direct-current, constant-field motor under increasing load.

Considering a transformer with, say, a ratio of 10 to 1, the decrease in magnetic flux with load seems at first glance hard to explain when we remember that for every additional 10 amperes passing through one turn of the secondary and therefore opposing the magnetic flux, we have 1 ampere traversing 10 turns of the primary and exerting an equal sustaining effect on the flux. As a matter of fact, their magnetizing effects would balance for each increment of load were it not for the fact that the primary current comes more into phase with the primary e. m. f. as the load increases. We must recall that at light loads the primary and secondary e. m. fs. are exactly opposed; that the primary current is nearly 90 degs. behind its e. m. f., and that the secondary current is in phase with the secondary e. m. f., and therefore opposed to but ahead of the primary current. The two e. m. fs. then, are in perfect opposition. The two currents are not because the primary current is not exactly opposite to the secondary current, but considerably behind it.

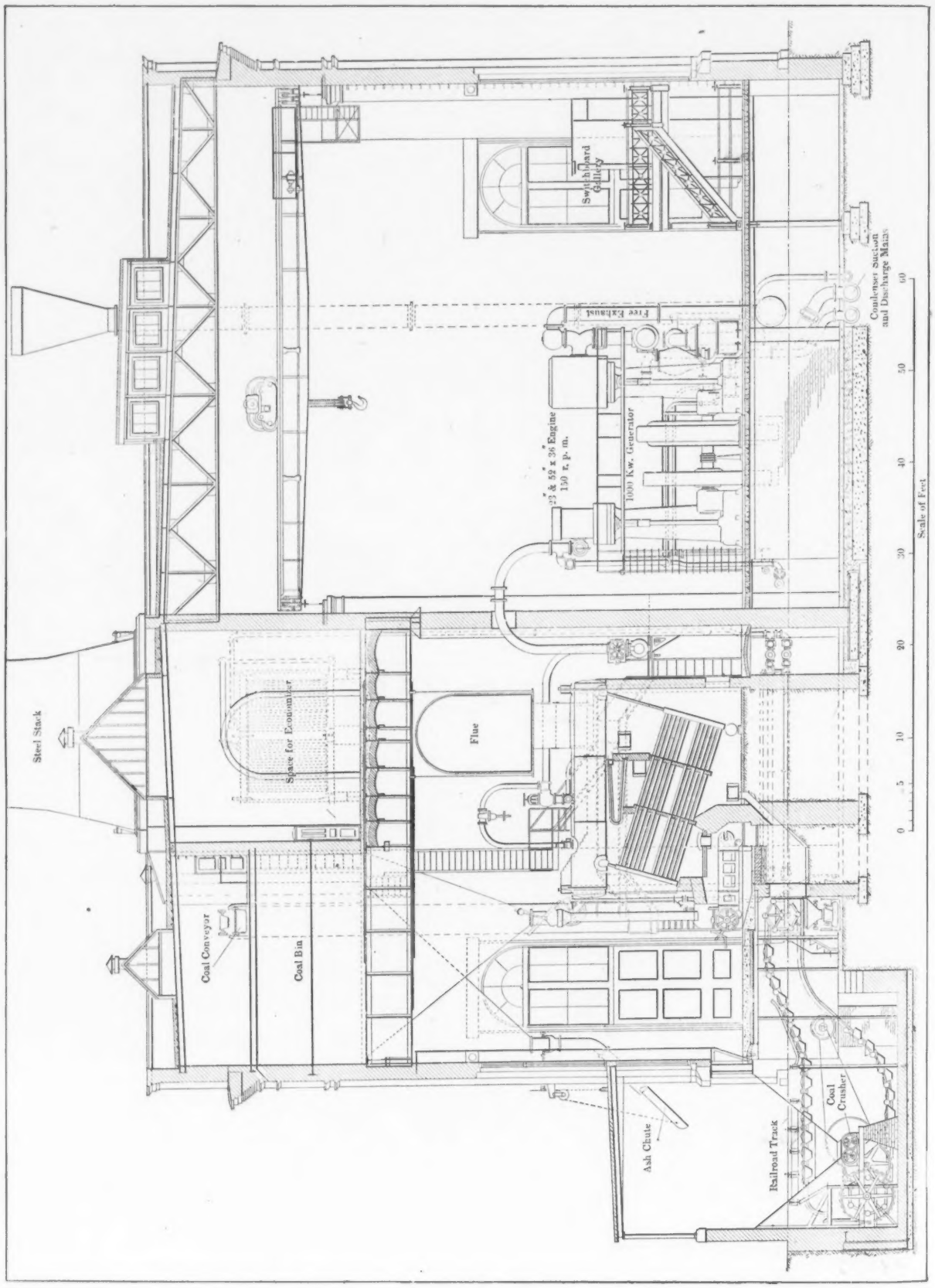
When, therefore, we load the secondary, we cause the primary current to advance in phase, thus becoming more completely opposed to the secondary current. Its magnetizing action is neutralized to a greater degree than before and gives rise to a smaller magnetizing resultant and consequently magnetic flux. Anything that operates to shift the phase of either primary or secondary current so that the former produces a smaller resultant with the latter, diminishes the magnetic flux and so the secondary voltage.

A non-inductive load does it because the primary current has moved forward into phase with its e. m. f. on account of there being less self-induction in the primary coil than before. An inductive load does it still more, because it not only shifts the primary current ahead, but causes the secondary current to lag somewhat behind, occasioning more complete opposition. On the other hand, introducing capacity into the secondary gives its current a lead, so that although the primary current has shifted forward as much as it did in the other instances, the two currents may be little more in complete opposition than they were before; therefore overcoming secondary drop.

Thus it will be seen that any influence tending to shift primary current forward or secondary current backward produces a drop of voltage in the secondary circuit, and vice versa, and this without any reference to magnetic leakage, whose influence, I feel convinced, in transformers of even fair design, is neither very considerable nor very variable with the nature of the load.

JOSEPH BIJUR.

NEW YORK.


Switchboard Gallery
Free Exhaust
Condenser suction and Discharge Mains
52" & 52" x 36" Engine 150 r. p. m.
1000 Kw. Generator
Steel Stack
Space for Economizer
Flue
Coal Conveyor
Coal Bin
Ash Chute
Railroad Track
Coal Crusher
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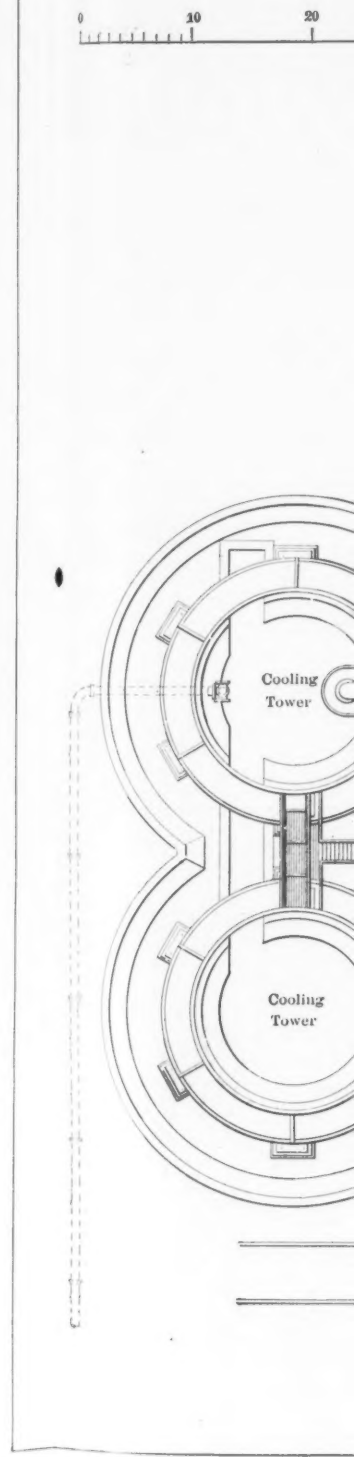
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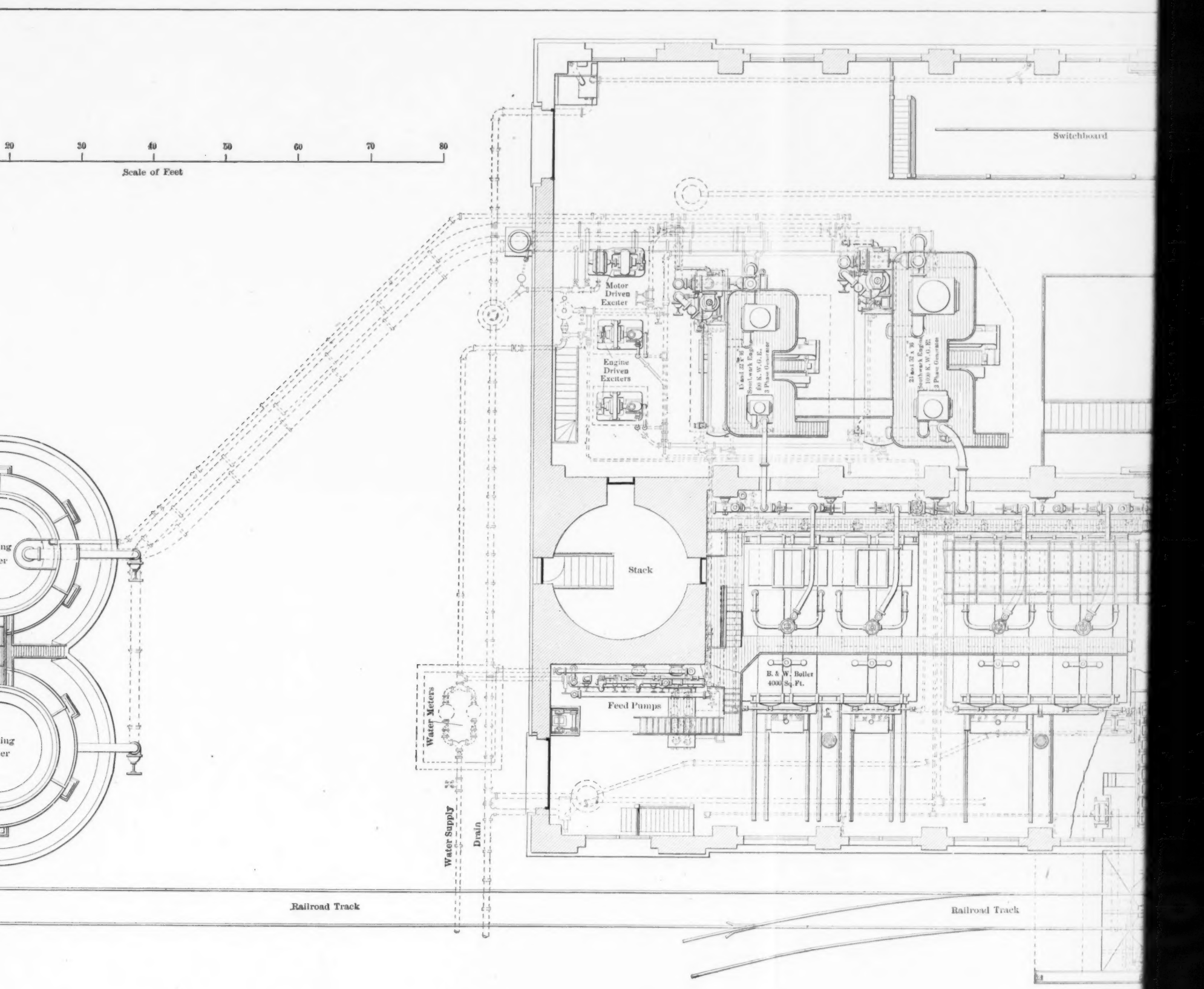
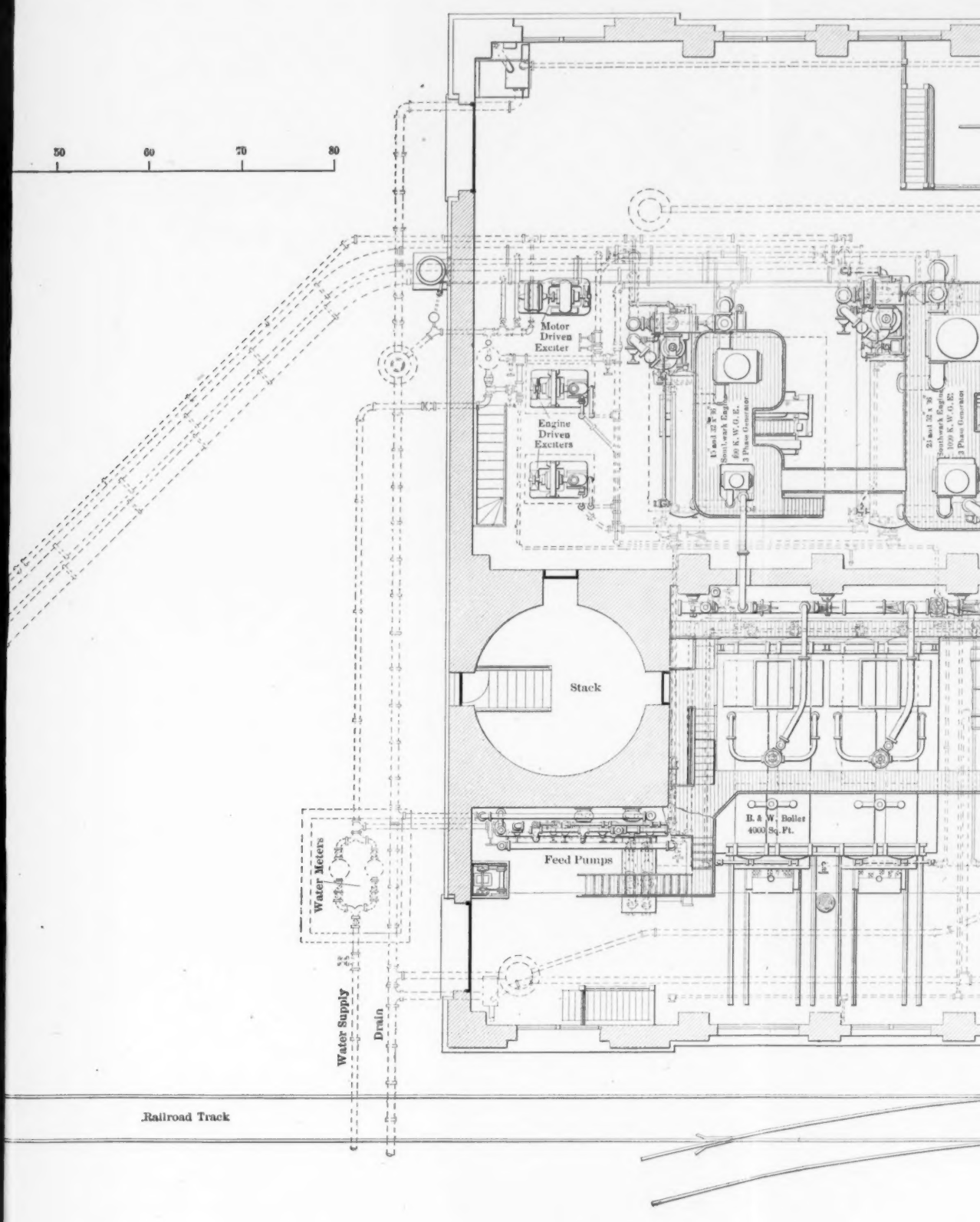
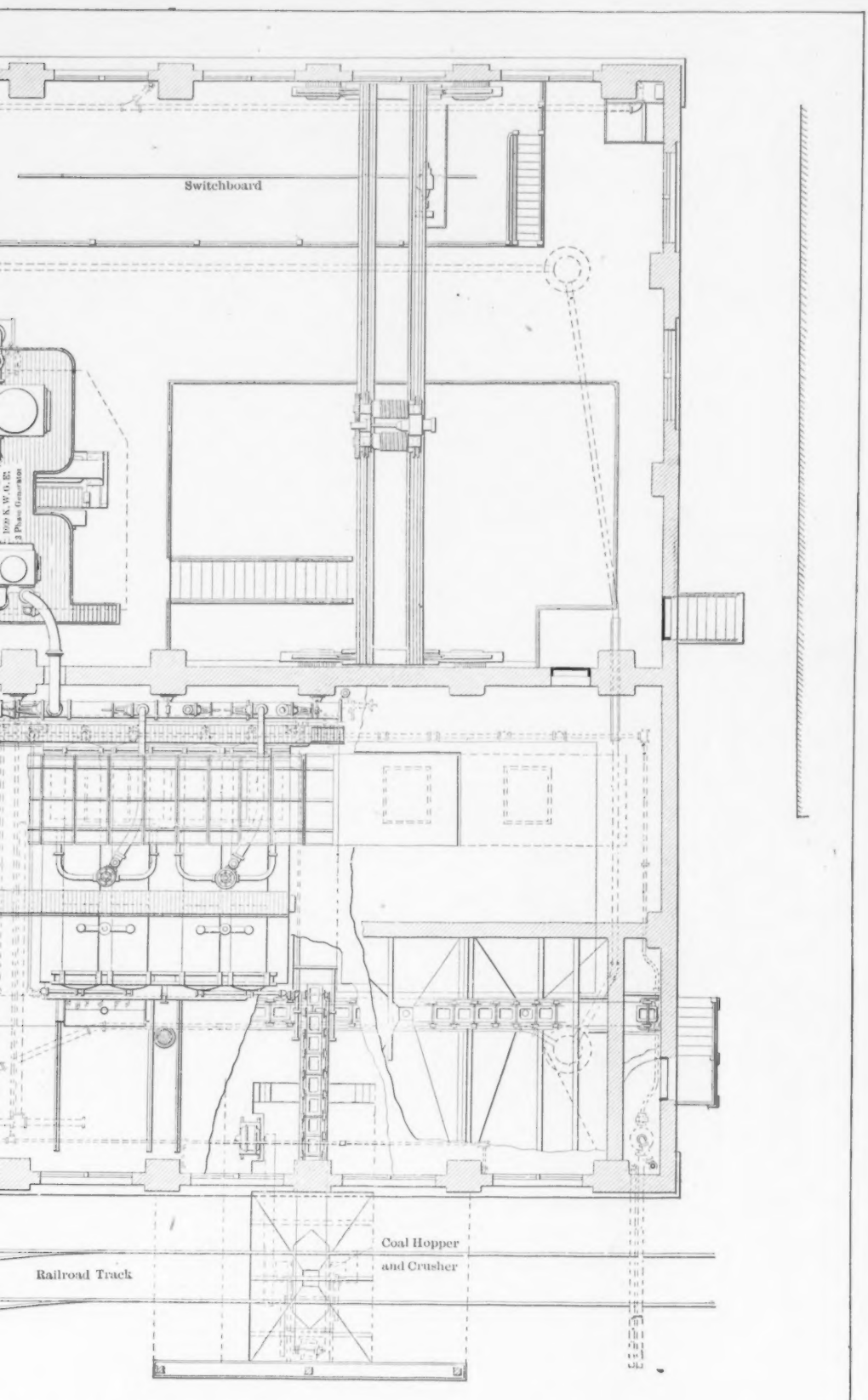
FIGS. 21 AND 2



AND 22.—SECTIONAL ELEVATOR THROUGH THE NEW 56TH STREET STATION OF THE COMMONWEALTH COMPANY, CHICAGO.



THROUGH THE NEW 56TH STREET STATION OF THE COMMONWEALTH COMPANY, CHICAGO.


Switchboard
Coal Hopper
and Crusher
Railroad Track

DIGEST
OF
CURRENT ELECTRICAL LITERATURE.

By CARL HERING.

DYNAMOS, MOTORS AND TRANSFORMERS.

Control of Motors Driving Printing Presses and Machine Tools.—A'BECKET.—A description of two methods of control, one of which consists of shunting the motor armature by a comparatively low resistance, and at the same time putting resistance in series with the shunted armature across the line, and varying the two resistances. The other method consists of winding the motor with four shunt field coils which are connected up in parallel, the speed regulation being obtained by throwing in or out one or more of the coils. A series field coil is used for the initial starting and one of the shunt field coils remains permanently in circuits during the operation of the motor.—*Amer. Elec.,* May.

REFERENCES.

The Speed Control of Motors on Constant-Potential Circuits.—ADAMS.—A summary and general comparison of the methods now in use for controlling such motors, including ordinary rheostat control, double-commutator control, multi-voltage control and control by field regulation.—*Amer. Elec.,* May.

Speed Control of Motors by the Variation of Impressed and Counter E. M. F.—MATHER.—A description and comparison of various methods for controlling constant-potential motors, including the well-known Ward Leonard system, a similar system in which the armature of an auxiliary dynamo is connected in series with the motor armature and made to oppose the impressed e. m. f. from the line; control by the commutation of series field windings on a motor; and control by supplying multi-voltage circuits. In one of the multi-voltage arrangements a motor balancer is used to maintain the division of voltage and in the other a storage battery; the diagrams show a six-wire system in which the voltage is different between each pair of wires, the motor armature being connected across different pairs of wires according to the speed desired.—*Amer. Elec.,* May.

Alternators Connected in Parallel.—CHEVRIER.—An illustrated theoretical article discussing by the graphical method, the case of alternators connected in parallel and acting upon a circuit of constant e. m. f.—*L'Eclairage Elec.,* Mar. 17.

Design for Combined Alternating and Direct-Current Generator.—BROCKSMITH.—A complete design with working drawings for a 4-kw machine to give 115 volts direct current and 80 volts alternating current.—*Amer. Elec.,* May.

Dynamos.—GUILBERT.—An article giving brief illustrated descriptions of recent improvements in continuous-current dynamos, taken from patent specifications.—*L'Eclairage Elec.,* Mar. 24.

Motors.—HOUEL.—The first part of an illustrated mathematical article on the theory of the continuous-current motor.—*L'Elec.,* Apr. 14.

Motors.—GILES.—A theoretical paper on the calculation of polyphase-current motors.—*L'Eclairage Elec.,* Mar. 24.

Alternators in Parallel.—BENISCHKE.—A long, illustrated French abstract of the German article noticed in the Digest, Jan. 13.—*L'Eclairage Elec.,* Mar. 3.

Short Circuit Curve of Alternators.—ARNOLD.—An illustrated French abstract of the German article noticed in the Digest, Jan. 13.—*L'Eclairage Elec.,* Feb. 24.

Dynamo Shafts.—SCHINDLER.—A mathematical article on the torsion strength and flection strength of dynamo shafts, giving formulas for the determination of the diameter of the shaft.—*Elek. Anz.,* Mar. 22.

Steam-Driven Dynamos.—Two illustrated communications on the question why in some dynamos direct coupled to a steam engine, the centre line of the field magnet is placed some distance nearer the flywheel than the centre line of the armature.—Lond. *Elec. Eng.,* Apr. 20.

LIGHTS AND LIGHTING.

The Weak Spot in Incandescent Lighting.—WILLCOX.—A plea for free and liberal lamp renewals by central station companies, based on the argument that the preponderance of poor incandescent lighting is due to the promiscuous purchase by the consumer of lamps of varying efficiencies and quality, and the consequent retention of dim lamps on the circuit beyond the period when they should be renewed.—*Amer. Elec,* May.

POWER.

Electric Driving of Heavy Machine Tools.—An abstract and criticism of an article from the Lond. *Engineer,* on the electric driving of some of the tools in one of the large Sheffield steel works. When electric driving was decided upon, a number of readings were taken which gave the power consumed by the various tools; recording ammeters were used for that purpose; the present writer thinks that a good commercial dead-beat ammeter is more suitable for such tests. Enclosed motors are used; the present writer says that for dusty work the choice lies between a totally enclosed motor and an open-type motor, he inclines towards an ordinary open-type motor, and if mechanical protection is advisable, to fit a wooden box over it, which can be lifted off bodily for inspection or cleaning. A good way of driving planing machines is to drive not less than three, from a separately driven shaft, if they can be arranged in a line, but the floor space and the most favorable position for the tool in a shop may not always permit this; besides, planing machines are not running for a large percentage of their time, so that there are advantages in being able to totally shut down the power by having a motor for each planer; each case must be judged on its own merits. The maximum power consumed in the large planers is at the end of the cutting stroke, while in most of the smaller size planers the maximum power is required at the end of the return stroke; this is due to the slower return speed of the planers mentioned, as compared with the cutting speed; in most small planers the return speed is considerably increased, keeping the cutting speed about the same.—Lond. *Elec. Rev.,* Apr. 27.

Electrical Equipment of the Armour Packing Establishment, Chicago.—SMITH.—An illustrated description of the new power equipment in the Armour establishment for supplying lighting and power current throughout the plant. The engines are cross-compounds and each drives an alternator by means of rope transmission and is also direct-connected to a Westinghouse direct-current generator which feeds into the motor circuits. There are 111 motors throughout the plant ranging in power from 1½ to 200 horse-power and aggregating 3600 horse-power total. Very few of these are individual machines, each motor as a rule driving groups of machinery, and in some cases one motor being used to drive an entire floor. A comparatively new type of steam boiler is used, consisting of a steam drum and mud drum connected by straight tubes, somewhat after the manner of the Cahall boiler. The tubes, however, are arranged in parallel rows, the forward rows being termed "risers" and the rear ones "downcomers." Inside the steam drum a baffle plate extends nearly over the rising tubes at a point near the water line. The function of this is to deflect the combined water and steam from the risers toward the rear tubes. The total boiler output is 9000 horse-power; the total alternating-current output is 750 kilowatts; the total direct-current output is about 2000 kilowatts; the surplus boiler output is used for driving air compressors, refrigerating machinery and pumps.—*Amer. Elec.,* May.

Live Steam Feed-Water Heaters.—DURAND.—A presentation of the fundamental principles governing the heating of feed-water by means of live steam, in the course of which the author states that a step-by-step heater used with a multiple-expansion engine has the first claim for consideration, and that such an arrangement properly installed may be expected to give all the advantages obtainable from feed-water heating. If the engines are simple and therefore without receivers from which to draw steam for the heater, then the supply may be taken from the steam mains with the assurance that there will be no thermodynamic losses, while there will be the gain due to the better working of the boilers when fed with hot water.—*Amer. Elec.,* May.

REFERENCE.

Closing the Water-Tight Compartments of Ships.—An illustrated article on the electrical method of Bowles.—*L'Elec.*, Apr. 7.

TRACTION.

Kei-Hiu (Tokyo-Yokohama) *Electric Railway.*—MORITA.—An article on this experimental Japanese line. The work was started in June, 1898, with a capital of $49,000, and traffic was commenced in January, 1899, under the name of the Taishi Electric Railway Co., which was amalgamated with the Kei-Hiu Electric Co. with a capital of $425,000. After the first experimental line had proved satisfactory, the company decided upon further extension, and the machines have now been ordered. The power-house equipment for the first experimental line, consists of two 60-hp vertical water-tube boilers for 120 lbs. working pressure, one Skinner 120-hp tandem-compound horizontal, 9 in. x 60 in. by 50 in. engine running at 250 revolutions, fitted with a ball jet condenser, and one Walker 75-kw generator direct coupled to the above engine. The present power house is located midway between Tokyo and Yokohama, and the extension of several sections will be made. The rolling stock consists of two cars with double motor equipment of 25 horse-power each, supplied by Walker & Co.; two cars of Japanese make with the same capacity, and one car with a single Sprague 15-hp motor; there are also three trailer cars. The trolley wire is hard-drawn copper wire of No. 000 B. & S. The present length of the line is 1¼ miles of double track. For the extensions, a battery of 265 Chloride accumulators will be installed, also one 100-kw continuous-current generator, one 160-hp engine and one 125-hp boiler. The gross earnings average $50 per day with an average number of passengers of 1774 per day.—*Electrical Friend*, Japan, Mar. 15.

Accumulator Traction,—An article on successful trials which have been made in Germany with accumulators on secondary railways and trunk lines, notably in Palatia and Würtemberg. Te accumulator motor cars, either singly or with trailers, follow a steam express train and stop at those stations which are passed by the express train. This has been done especially on roads where the service was too light and the distances too great to make a trolley line economical. On the narrow-gauge local road between Ludwigshafen and Mundenheim, four accumulator cars have been in constant use since January, 1897, each having two motors, geared to run at a speed of 28 to 32 miles per hour. The batteries have a capacity of 200 ampere-hours. On a level road and with favorable weather conditions, the energy consumed was 29 watt-hours per ton-mile at a speed of 25 miles per hour; with heavy head winds this was increased to 43 watt-hours. An empty motor passenger car weighs 11 tons, the battery 9.3 tons, motor and apparatus 4.1 tons, the trailer 10 tons; so that the whole train empty weighs 34.4 tons, and fully loaded about 40 tons. The positive plates have been in use for over 18,600 train-miles.—*St. R'y Jour.*, May.

Train Unit Systems.—A fully illustrated account of a series of comparative tests of the Sprague, Westinghouse and General Electric train unit systems, made recently in the Boston Subway in the early morning hours for about two weeks. In all three systems the motorman in the forward car of the train of motor cars operates all the motors on the different cars in unison. Runs were made with one, two, three and four cars, and the current consumption, acceleration, etc., were determined. Special care was taken to observe any differences of acceleration, when one car was run and when more than one, as this would show a lack of unison in the action of the separate controllers on the train. The trial track contained an 8 per cent grade, with a reverse curvature having a 90 ft. radius at the foot of the grade. The current was 800 to 1000 amperes per car for 3200 to 4000 amperes for the four-car train. The results of the tests are now being worked up by the engineer. Illustrated descriptions are given of the General Electric system and of the recently improved Westinghouse system.—*St. R'y Jour.*, May.

Traction Motor Suspensions.—E. K. SCOTT.—The second part of his illustrated article (Digest, May 12), dealing with gearless motors. An early form with Gramme winding and a newer form with drum armature, are illustrated and described. Although extensively used, the method of having four bearings on the axle, two for the axle boxes and two for the motor, is said to be wrong in principle, because the actual movement of the motor field casting is very slight, being merely that due to the compression of the suspension springs. He suggests dispensing with two extra bearings on the axle by the use of cannon bearings; the motor casting does not rest on the axle at all, but is supported on projections forming part of the axle boxes. This method necessitates the use of a cantilever axle, that is, the wheels must be outside the bogie truck instead of inside; this method cannot be applied very well to geared motors or tram cars.—Lond. *Elec. Rev.*, Apr. 20.

Consolidation of Small Roads.—An editorial on the mechanical economies of the amalgamation of small electric railways. For four neighboring roads each of 200 kilowatts, and operating six or eight cars, the cost of generation of power is about 5 cents per kilowatt-hour, and the average load of each station is not much over 40 per cent of the maximum load. By a consolidation of these four roads, the total power capacity is not to be over 600 to 700 kilowatts and the cost of operation is reduced to somewhat less than 2 cents per kilowatt-hour. Much saving is effected also in power distribution and in the reduction of the reserve supply in rolling stock.—*St. R'y Jour.*, May.

Surface-Contact System.—An illustrated description of the lines of Monaco, which have grades in some places as high as 9 per cent. There are two lines of contact blocks placed between the rails; for one set of blocks the current is taken from the underground feeder wires to the motors, while the other set constitute an auxiliary system of service whereby the first row of blocks are thrown into connection with the feed wire.—*St. R'y Jour.*, May.

REFERENCES.

Tramways in Reichenberg.—SCHOOP.—A long, illustrated French abstract of the German article on the storage battery in the tramway power house of Reichenberg (Digest, Oct. 7).—*L'Eclairage Elec.*, Mar. 17.

Moscow.—An article on the proposed changes in the tramway system of Moscow. All lines are to be operated electrically. The power station is to generate three-phase current, which is to be converted at sub-stations into continuous current for use on the trolley line.—*St. R'y Jour.*, May.

Paris Exposition.—A description of the three lines of travel which exist in the Paris Exposition grounds: The moving platform, an electric railway parallel to it operated by a third rail except in the switching yards, where an overhead trolley is used; and the terminal of the Western Railroad which enters the grounds and is operated by an electric locomotive.—*St. R'y Jour.*, May.

Halifax.—A short, illustrated description of the electric railway system of Halifax. The chief features of interest are the grades, which are sometimes between 8 and 9 per cent, and the method of caring for snow with snow-sweepers carrying three motors, two for driving the sweeper and one for revolving the brushes.—*St. R'y Jour.*, May.

Dublin.—A long and fully illustrated description of the new power station of the Dublin United Tramways Co., which was already noticed in the Digest. Also of the Dublin and Lucan tramway, which is a short line formerly operated by steam and recently equipped with electricity.—*St. R'y Jour.*, May.

Germany.—An article giving some notes on Germany. Reference is made to the disturbances of magnetic observatories by street railway currents, as noticed in the Digest, Mar. 31, Apr. 7; also to the annual report of the Berlin tramway lines, the net receipts of which have increased more than a quarter of a million dollars. Some figures are given for the electric railways in Saxony.—*St. R'y Jour.*, Int. Ed., May.

Destruction of Iron Pipes by Electrolysis.—An illustrated description of a recently patented device of Knudson, the object of which is to prevent the shunting of stray electric currents around pipe joints; also to provide a method of electrically bonding pipes that ensures a permanent connection and one that will not deteriorate in time through oxidation. The details of the method are described and illustrated, and the results of some tests are given which show that the method seems to be effective.—*El'ty*, May 9.

INSTALLATIONS. SYSTEMS AND APPLIANCES.

Compensation of Phase Differences.—An illustrated description of the Boeninger method of compensating for the phase difference in an alternating-current system. If there is a certain reactance in the circuit, he inserts in series a capacity reactance of the same value; if there is a certain capacity reactance in the circuit, he inserts in series an inductive reactance of the same value. Three methods are described. The first is that the compensating reactance is furnished by the armature of a small alternator which runs synchronously with the generator; the field magnets of this auxiliary machine are

arranged in a position which is different from the main generator by a quarter of a period; the excitation of the magnets is regulated by an automatic switch which is not described.—*Elek. Rund.*, Apr. 15.

REFERENCES.

Accessories for 220-Volt Lamps.—ZETTER.—An abstract of a paper read before the International Society of Electricians in Paris in which he described circuit-breakers, commutators and sockets for 220-volt incandescent lamps.—*L'Eclairage Elec.*, Mar. 17.

Action of Storage Batteries.—KOHN.—A long, illustrated French abstract of the German article noticed in the Digest Feb. 24.—*L'Eclairage Elec.*, Mar. 17.

WIRES, WIRING AND CONDUITS.

Electrical Conductors and Dust.—SWINTON.—A brief article describing some interesting observations made in his new office rooms There are five plain pendant fittings with flexible cords starting from ceiling roses on the wall. The supply is continuous current at 200 volts; three of the pendants are upon one switch, the two others upon another. He observed soon that the first three flexible cords remained clean, while the other two were rapidly accumulating dust; the latter were repeatedly dusted, but the effect always repeated itself. The reason was found to be that for the first three pendants the switch was in the positive pole; for the other set, whose cords and roses became covered with dust and even blackening the ceiling with which they were not in contact, the switch was in the negative pole. He calls attention to the fact that the negative conductor in the street mains has a tendency to earth itself to an extent sufficient to cause the negative lead to be always almost at the same potential as the earth; by a voltmeter test in his office he found that from the negative there are only about 30 volts to earth, while from the positive there are 170 volts. Therefore in the case of the three pendants whose switch is in the positive, it is only when the switch is turned on a few hours per day out of the 24, that there is any appreciable difference of potential between the cord and the surroundings; even then it is only one conductor in the cord that has this potential, and the exterior of the covering very possibly always retains zero potential. In the case of the other set of two lamps, whose switch is in the negative, during many hours every day, when the switch is turned off, both of the conductors remain constantly at a potential of 170 volts above that of its vicinity; the dust is therefore caused to deposit upon the cord and upon the ceiling rose by electrostatic attraction. He concludes that for cities with an atmosphere like London, with the switches in the negative, an amount of dirt will be deposited in a few weeks that would take years to accumulate with the switch in the positive. From a totally different point of view, in damp situations, there is an advantage in putting the switch in the negative, for the reason that otherwise the metallic mechanism of the switch is liable to be corroded away by electrolytic action. In dry places, however, where it is always desired to keep electrical wires and fittings clean, switches should always be placed in the positive conductor, so that the exteriors of such fittings and wires should remain as far as possible at earth potential.—Lond. *Elec.*, Apr. 27.

ELECTRO-PHYSICS AND MAGNETISM.

Radium and Cathode Rays.—BECQUEREL.—An account of experiments showing the identity of at least one kind of Becquerel rays—Curie's radium rays—and of cathode rays. Not only do both transport an electric charge, but both are also subject to electrostatic as well as magnetic deflection.—*Comptes Rendus*, Mar. 26; abstracted in Lond. *Elec.*, April 27.

Sparking Potentials in Solid and Liquid Dielectrics.—ALMY.—An illustrated abstract of a dissertation giving an account of a series of experiments. The apparatus used for solid and for liquid dielectrics are illustrated and described. For both kinds of liquids the potential at which a spark discharge goes through the dielectrics was found to be a linear function of the thickness of the dielectrics. To produce sparks through a thickness of 0.1 cm, for Jena glass, 83.5 c. g. s. units are necessary, for mica 1890, for paraffine 375, for turpentine-oil 161, for petroleum 212, for xylole 174.—*Elek. Zeit.*, Apr. 19.

REFERENCES.

Distorted Curves.—FRY.—An illustrated mathematical article describing a method of resolving a distorted curve into a fundamental of the same frequency and a number of higher harmonics, according to Fourier's theorem. The method is simple and elementary, but cannot be abstracted here.—*Jour. of Elec.*, April.

Mutual Induction.—HERZOG and FELDMANN.—An article, illustrated by many diagrams, showing how to apply the graphical method of combining impedances to problems dealing with mutual induction between different circuits. The article does not seem to give anything new, but is a clear and brief outline of the method.—*Elek. Zeit.*, Apr. 19.

Surface Electrification of Vacuum Tubes.—RIECKE.—A French abstract of the German paper noticed in the Digest, Feb. 10.—*L'Eclairage Elec.*, Mar. 17.

Roentgen Rays.—ROLLINS.—A description of some experiments with twin Roentgen-ray tubes, which are illustrated.—*Elec. Rev.*, May 2.

ELECTRO-CHEMISTRY AND BATTERIES.

Plante Plates.—BECKMANN.—A description of a method which he has devised for forming Planté plates. The old Planté method of forming the plates in pure dilute sulphuric acid is a good one, but expensive and takes a very long time. To overcome these disadvantages several methods have been developed for quick formations, by means of addition of substances acting rapidly upon the lead anode, like chlorine; but all these processes have the great disadvantage that the formation, i. e., the production of peroxide of lead from the metallic lead of the plate is not completed when the plate has been taken out of the formation electrolyte and has been put into the cell; on the contrary, the action continues and the lead core is destroyed after a comparatively short time. To prevent this, it was tried to send a reverse current through the formed peroxide of lead plate in the formation liquid and to change the peroxide entirely into metallic lead, in order to remove any remaining trace of chlorine, etc., but this method did not prove successful. He claims to prevent this subsequent action by the use of a different electrolyte. For the electrolytic formation of peroxide of lead the presence of free sulphurous acid is very advantageous. He puts metallic lead as positive electrode, into an equeous solution of free sulphurous acid, which is produced either by conducting free dioxyde of sulphur into water, or by dissolving in water a salt which developes dioxyde of sulphur with an acid, and adding an acid. If then the current is switched on, a good layer of peroxide of lead is at once produced. The advantage of this process is that no substances are used which are detrimental to the plate. It is therefore not necessary to send a reverse current through the plate after the formation; all the dioxyde of sulphur is transformed into sulphuric acid during the process of forming and therefore cannot continue its action later, in the accumulator. He says that this method has proved very satisfactory in laboratory tests covering a long period of time.—*Centralblatt fuer Accum. und Elem. Kunde*, Apr. 15.

Lead Accumulator.—DOLEZALEK.—A brief article on the temperature coefficient of the lead accumulator. Streintz measured the same for concentrations of the acid between 1.144 and 1.173 and always found it to be positive and to have a maximum for a concentration of 1.160 (22 per cent of sulphuric acid); he found also that the temperature coefficient is independent of the temperature between 10° and 70° C., i. e., that the e. m. f. is a linear function of the temperature. The present author starts from the formula of Helmholtz for the temperature coefficient (deduced from the second principle of thermodynamics) and supposes that the thermo-chemical heat of reaction (of Thomson's law) is independent of the concentration for small concentrations of acid. He thus obtains a formula for the temperature coefficient as a function of the acid concentration, applying to concentrations between 0.1 and 0.0005, which shows that, below the concentrations used in the measurements of Streintz, the temperature coefficient must quickly decrease to zero and become negative for small values of the concentration. He made an experimental investigation, the results of which are in agreement with his theoretical conclusions. The temperature coefficient was found to have positive as well as negative values, according to the concentration of the acid. He found also the maximum observed by Streintz, and that for very dilute acids the e. m. f. is also a linear function of the temperature, which appears from a diagram for an acid 0.0005 normal. He remarks that if a very dilute solution is used, the accumulator may be used as a very effective thermo cell, by connecting in opposite directions two cells filled with such solution, the one being held at, say, 10° C., the other at, say, 100° C. An e. m. f. of 0.6 volts is thus obtained. When the cold cell is discharged, the warm cell is charged, and it is only necessary to heat the former and to cool the latter, in order to enable the system to furnish current again

at the expense of the heat supplied. An accumulator, filled with such a dilute acid, is, of course, no apparatus which can be used in practice. It may be, however, that a high temperature coefficient can be obtained with an electrolyte which can be used in practice. "The lead-peroxide-lead cell would thus be not only an excellent accumulator, but at the same time a very good generator, which would enable one to dispense with the steam engine for the generation of current."—*Zeit. fuer Elektrochemie*, Apr. 19.

Tobiansky Accumulator.—BAINVILLE.—A brief article criticizing some figures in the article of Foresio (Digest, March 31). The weight of the Tobiansky accumulator has not been reduced to one-half that of the usual automobile accumulator; the weight of the electrodes is only 10 per cent smaller, but the electrodes represent only 60 per cent of the total weight.—*L'Elec.*, Mar. 31.

REFERENCES.

Charging Accumulators at Constant Pressure.—HEIM.—The first parts of a very long paper which was read in abstract before the Union of German Electrical Engineers. Charging at constant pressure is now used in all cases, where a long time is not available for that purpose, as with accumulator tramways, automobiles, batteries for train lighting, etc. He made a long series of experiments to find the influence of this kind of charging upon the capacity and efficiency. In the present parts of the paper he describes in detail the cells used and the method of measurements; also some of his experiments with charging at constant current, and at constant pressure.—*Elek. Zeit.*, Apr. 5, 12, 19.

Accumulator Plant.—An illustrated description of the Oberspree accumulator works near Berlin.—*Centralbl. fuer Accum. und Elem. kunde.*—Apr. 15.

Jeanty Primary Battery.—MONTPELLIER.—An illustrated article on this battery which was described in the Digest, July 22, 1899.—*L'Elec.*, Mar. 31.

Primary Batteries.—OVERBURY.—An article on primary battery troubles, discussing the influence of the equality and porosity of the carbon electrodes, and of the purity of the zinc, the water, and the excitant.—*Elec. Rev.*, May 2.

The Electrolytic Production of Soda and Chlorine.—HOBART.—The continuation of his serial. He gives an elementary presentation of the principles of electrolysis and its particular relation to the production of soda and chlorine.—*Amer. Elec. Mag.*

UNITS, MEASUREMENTS AND INSTRUMENTS.

Testing the Magnetic Properties of Sheet Iron.—EPSTEIN.—A long, illustrated description in detail, of a method which the principal German electric manufacturing companies have agreed to use in their magnetic tests of sheet iron, and those methods which each is using besides. It is said to give results which are in sufficiently good agreement for practice, with the very strict and exact methods of the German Reichsanstalt. The wattmeter method is used to determine the whole iron loss; the magnetic circuit contains no other iron than that to be tested, and the magnetizing force is distributed uniformly over the whole magnetic circuit, to prevent straying. The hysteresis and eddy currents losses are separated from each other with the aid of the well-known formulas which give both losses as functions of the maximum inductions and the frequencies. There is often a great difference between different samples of sheet iron taken from the same shipment, and sometimes even between samples taken from the same sheet.—*Elek. Zeit.*, Apr. 19.

Electrolytic Interrupter.—RZEWUSKI.—A description of an electrolytic interrupter for low pressures, such as 24 volts. Through a properly placed glass tube, dilute acid flows from below against an active platinum electrode. A fall of one meter is sufficient, in order to make the acid flow out under the right pressure at 24 volts. If the mechanical pressure is chosen too great, the interrupter does not operate.—*Ann der Physik.*, 1900, p. 614; abstracted briefly in *Elek Zeit.*, Apr. 19.

Measuring the Conductivity of Poorly Conducting Liquids.—GRAETZ.—A paper on the phenomenon observed by Quincke that a globe of insulating material, when suspended between the plates of a liquid condenser filled with an insulating liquid, rotates continuously when the condenser is charged at a constant pressure. He shows how to use this phenomenon, to determine the conductivity of liquids which are poor conductors. He used spheres of sulphur, ebonite or paraffin, and found by this method that the conductivity of benzole or ether increases when these substances are traversed by Röntgen rays.—*Ann. der Phys.*, No. 3, p. 530; abstracted in *Elek. Zeit.*, Apr. 19.

Plotting Alternating-Current Curves.—NIETHAMMER.—A brief article, illustrated by diagrams, pointing out that the different methods of plotting an alternating wave by determining instantaneous values give results which are quantitatively very inaccurate and do not agree well together. All methods are unreliable, when the contact resistance in Joubert's method, or the breadth of the contact, have an influence upon the results. He criticizes several methods and

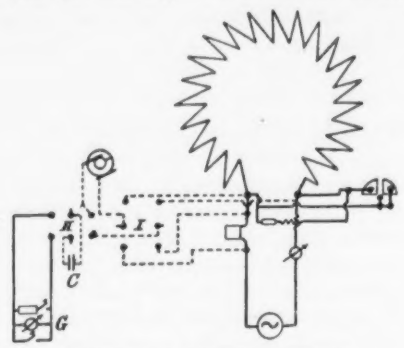


DIAGRAM OF JOUBERT METHOD.

says that he has found the simple method of Joubert, of plotting the curve with the condenser C, the commutator H and the ballistic galvanometer G, as illustrated in the adjoining figure, is the most reliable, although not the quickest and most convenient. The contact resistance then has no effect on the result, neither does a small variation of the breadth of contact influence the result considerably.—*Elek. Zeit.*, Apr. 19.

REFERENCE.

Photometry for Central Stations.—REED.—The first of a series of articles, the purport of which is to explain the principles of photometry, and urge upon central-station managers the necessity for conducting tests of all incandescent lamps purchased.—*Amer. Elec.*, May.

TELEGRAPHY, TELEPHONY AND SIGNALS.

Fire Annunciator.—A note describing a simple form devised by May. A copper wire of about 18 gauge, and 20 feet in length, is stretched on the wall of each room of the house, in which the annunciator system is installed. To the centre of this wire a small carbon-tipped weight is suspended, and when the temperature of the room rises above a certain value, the sag of the wire causes the weight to come in contact with a platinum point and thus closes the circuit of a bell and indicator. For houses within reach of the fire brigade it is proposed to place the indicator on the front of the house and to connect it with an automatic Morse transmitter.—Lond. *Elec.*, Apr. 27.

Pollak-Virag System.—FLEURY.—An article discussing the practicability of this system of telegraphy (ELEC. WORLD AND ENG., July 15, 1899), for commercial use, when compared with other systems. He concludes that it is not so apt to meet the conditions of ordinary practice, and that the Baudot system corresponds more completely to the actual necessities of telegraphy.—*L'Elec.*, Mar. 24, Apr. 7.

REFERENCES.

Telephone Switchboard.—MONTILLOT.—An illustrated article on the Ducousso telephone switchboard. Two arrangements are described, the one for establishing communication between any two lines connected to the switchboard in such a way that the conversation can be listened to in the central station, the other not allowing the conversation to be heard on the station.—*L'Elec.*, Mar. 24.

Telephone and Telegraph Lines.—PIERARD.—A mathematical article on the stability of the spans of telephonic and telegraphic bronze wires under the influence of frost.—*L'Elec.*, Apr. 14.

Interior Telephone Systems.—HENRY.—A summarization with explanatory diagrams, of the more simple intercommunicating telephone systems suitable for use in offices and factories.—*Amer. Elec.*, May.

Electric Block Signals.—KRIZIK.—A long, illustrated French abstract of the German article noticed in the Digest Sept. 9.—*L'Eclairage Elec.*, Mar. 17.

MISCELLANEOUS.

Japan.—An editorial note on the manufacture of electrical machines and of wires and cables in Japan. No submarine or lead cables were ever made in that country; they are imported from America and England, and it is thought that it may take a long while before their manufacture is undertaken in that country. Telephone apparatus is made largely in Japan, except the receivers and transmitters,

which are mostly purchased from the Western Electric Co. Searchlight fittings are mostly imported from foreign countries, but some of them, especially batteries and miniature lamps, are all made in Japan, and the imports have been greatly reduced. Continuous-current low-voltage generators and single-phase alternators are made in Japan, and said to be quite as satisfactory as American machines, and to cost but 70 to 80 per cent of the latter. The manufacture of polyphase machines is not so satisfactory at present, but there are good prospects for their future development. Engines for dynamo driving, made in Japan, are not very satisfactory in regulation, especially for high-speed service. Neither are turbines, except some impulse turbines. The cotton braided wires are almost exclusively made in Japan, and are said to be very satisfactory. The rubber insulated wire manufacture is still in the experimental state, and all such wire is imported.—*Electrical Friend,* Japan, Mar. 15.

Protection of Buildings from Lightning.—HEDGES.—A long abstract of a paper read before the Royal Institute of British Architects. He repeated Lodge's statement that the problem does not end with the actual rod, owing to the large difference of potential existing between the conductor and earth, however well the two are connected. He expressed himself in agreement with Lodge as to the oscillatory nature of the discharge, and claimed that the side flash was the result of self-induction in the conductor. He considered that when a discharge occurred at one point between a thundercloud and earth, a corresponding discharge occurred in the reverse direction at another point of the cloud. He referred to these as the "downward" and "upward" discharges, and stated that he had frequently seen in Colorado "upward" flashes arising from the ground. He describes the lightning conductors attached to the Notre Dame Cathedral in Paris, to the Cologne Cathedral, to the Palais de Justice of Brussels, the methods generally used by French and by American architects, and discussed the rearrangement of the lightning conductors on the St. Paul's Cathedral in London. He does not agree with Lodge that the use of copper is a needless extravagance, but prefers it to iron, as a lightning conductor is costly to renew, and iron perishes more quickly than copper.—Lond. *Elec.,* Apr. 27.

Physiological Action of High Frequency Currents.—An account of experiments made by Querton to examine the statement of d'Arsonval that the action of the digestive organs is increased by placing the body in a solenoid traversed by high frequency currents. He experimented with guinea pigs, and determined the carbonic acid given out by respiration. He did not find the least increase in the production of carbonic acid, when the guinea pigs were placed in the energized solenoid.—*L'Elec.,* Mar. 31.

REFERENCES.

Electricity and Engineering.—PREECE.—A James Forrest lecture, delivered before the British Institution of Civil Engineers, on the relations between electricity and engineering.—Lond. *Elec. Eng.,* Apr. 27; long abstracts also in Lond. *Elec.* and *Elec. Rev.,* Apr. 27; also an editorial, criticising it, in Lond. *Elec.,* April 27.

Electrical Engineers in the War.—An illustrated article on electrical equipment of the British electrical engineers volunteer corps which has gone to the South African war. The traction engines, the specially-designed searchlight equipment, the limbers, the cable drum carriages, and the telephone equipment, are described and illustrated. —Lond. *Elec., Elec. Rev., Elec. Eng.,* Apr. 27.

Educational.—ELBS.—An illustrated description of the physico-chemical laboratory of the German University of Giessen, which contains also rooms for electro-chemical work.—*Zeit. fuer Elektrochemie,* Apr. 26.

Historical.—The first article of a serial on electrical pioneers of the Pacific coast, dealing with the life and work of William Lundberg.—*Jour. of Elec.,* April.

Electrically-Heated Theatre.—JONES.—A brief, illustrated description of a method adapted for heating a theatre in Buenos Ayres. Resistance coils in boxes in the cellar heat up the air, which is conducted through pipes to the theatre.—*Elec. Rev.,* May 2.

Magnetic Separators.—MCNEILL.—A long, illustrated French abstract of his paper noticed in the Digest Sept. 30.—*L'Elec.,* Mar. 24, 31.

Aluminum.—An article of a general nature of some methods of soldering aluminum. It does not seem to contain anything new.—*Cosmos,* Apr. 21.

Steering Torpedoes by Means of Wireless Telegraphy—TALBOT.—A brief article on experiments made by Varicas in England.—*Sc. Amer.,* May 12.

New Books.

IMPIANTI DI ILLUMINAZIONE ELECTRICA HOEPLI. Di Emilio Piazzoli. Fourth edition, revised. Milano: Ulrico Hoepli. 64 pages, 261 illustrations, and 113 tables. Price, 6.50 lires.

Of the celebrated "Manuali Hoepli"—now numbering 600 volumes—doubtless none outranks in merit Piazzoli's practical manual of electric lighting, now entering upon its fourth edition. The plan of the book is excellent, combining with a concise resumé from the practical standpoint of each branch covered the data usually found in handbooks or so-called pocketbooks of electrical engineering.

An example of the treatment, in the two chapters on the dynamo, the principles of direct, single-phase and polyphase machines and motors are briefly, but clearly set forth, types of fields and armatures illustrated, and kinds of windings and connections described. The formulas used in dynamo design are then given and illustrated by an example. Next are sections on dynamo testing, and on installation, management and repair, followed by a number of pages on coupling in series or in parallel, with diagrams of circuits.

The chapter on illumination and electric lamps gives instructions for photometric tests and the determination from lamp curves of the distribution of illumination for a given distribution of lamps. Perhaps the most valuable section is one on the calculation of conductors, which is very complete and thoroughly considers the calculation of networks. In the course of the development of a subject, tabulations of the practical data relating to it are interpolated, and examples of the application of principles and data given. An excellent sale awaits a book written in English after the plan of the one here reviewed.

STANDARD POLYPHASE APPARATUS AND SYSTEMS. By Maurice A. Oudin. Second edition, revised. New York: D. Van Nostrand Company. 249 pages, 159 illustrations. Price, $3.00.

That a second edition of this work should be required so shortly after its original issue, indicates that it answers to a real need. It is, in fact, the only work in the language which treats adequately of the very latest commercial developments in alternating currents, and from which one can obtain explicit information concerning the newest types of apparatus. It has the advantage of being so written as to require no special electrical knowledge for its understanding, thus appealing to a large class hitherto barred from the literature of alternating currents owing to its mathematical or special character. On the other hand, much of the data and information will be appreciated by the professional engineer.

BOOKS RECEIVED.

THE GAS-ENGINE HANDBOOK. A Mannual of Useful Information for the Designer and Engineer. By E. W. Roberts. Cincinnati: The Gas Engine Publishing Company. 220 pages, 184 illustrations. Price, $1.00.

THE LAW OF ELECTRIC WIRES IN STREETS AND HIGHWAYS. By Edward Quinton Keasbey. Second edition, revised and enlarged. Chicago: Callaghan & Company. 358 pages. Price, $5.00.

ELEKTROMETALLURGIE UND GALVANOTECHNIK. Ein Hand-und Nachschlagebuch fur die Gewinnung und Bearbeitung von Metallen auf elektrischem Wege. Von Dr. Franz Peters. Four volumes. Wien: A. Hartleben, 261, 292, 208, 240 pages; 72, 119, 59 and 33 illustrations. Price, per volume, 3 marks.

Directory of Electrical Societies, Etc.

NORTHWESTERN ELECTRICAL ASSOCIATION. Next meeting, Waupaca, Wis., June 26, 27 and 28, 1900.

CHICAGO ELECTRICAL ASSOCIATION. Annual banquet, May 18.

CANADIAN ELECTRICAL ASSOCIATION. Next meeting place and date to be announced later.

AMERICAN STREET RAILWAY ASSOCIATION. Next meeting, Kansas City, Mo., Oct. 16, 17, 18 and 19, 1900.

NATIONAL ELECTRIC LIGHT ASSOCIATION. Next meeting, Chicago, May 22, 23 and 24, 1900.

NATIONAL ASSOCIATION OF MUNICIPAL ELECTRICIANS. Next meeting, Pittsburg, Pa., Sept. 25, 26 and 27, 1900.

AMERICAN ELECTRO-THERAPEUTIC ASSOCIATION. Next meeting, New York, Sept. 25, 26 and 27, 1900.

Telpherage.

Telpherage, according to Prof. Fleeming Jenkin, who invented the word, is the "Transmission of vehicles by electricity to a distance independently of control from the vehicle." The word is derived from two Greek words meaning far-carrying, the first syllable being the same as that in the words telephone and telegraph. A telpher is an electric car used for telphering or automatically carrying goods or other material. The telpherage idea is old, yet new; old, as the electric railway was old, before the advent of the Sprague system in 1887, yet new at present, as that system was new in 1887.

As much of the original work in telpherage was devoted to overhead cableways, the meaning came gradually to be restricted to electric aerial transportation, but is now generally restored to its original meaning and applies not only to cableways, but to electric automatic transportation, whether overhead, surface or underground. Telpherage has, however, its own peculiar field, and this was most clearly expressed by Prof. John Perry who, with Prof. W. E. Ayrton, has devoted much time in the past to the scientific and commercial development of telpherage. In a lecture delivered by Prof. Perry, he shows the great possibilities of telpherage, and states that "the commercial success of telpherage depends upon the conveying of light loads and the sub-division of material." Telpherage is not therefore a competitor of existing railways for passengers or for bulky or heavy freight. Another authority says, "The crowds handled by street companies on holiday occasions, which far exceeds the capacity of a double-track railway as ordinarily operated, seems remarkable. But the condition of an electric or cable road is that of a large number of small units following each other in quick succession and at a uniform speed." It is upon this principle that telpherage lines are operated, and the amount carried and the results that may be achieved are most remarkable.

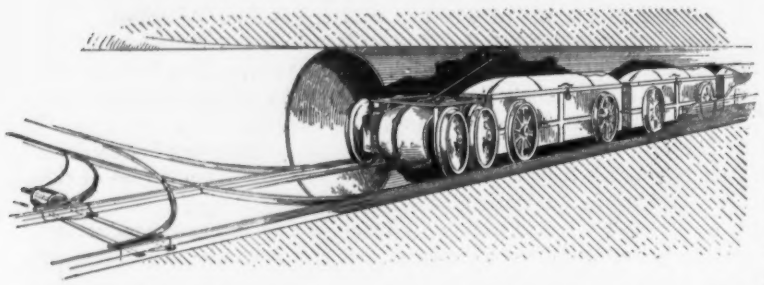


FIG. 1.—ELECTRIC TUBULAR DESPATCH (UNDERGROUND).

A few of the different kinds of material for the handling of which telpherage is especially advantageous are all kinds of grain and other agricultural products, such as cotton, coffee, fruits and small farm produce; raw and finished material to and from mills; ore, slag, ashes, cement, clay, coal, gravel, phosphates, sand; every description of light merchandise; parcel and express deliveries, and mail matter from letters to books. This last use might be greatly extended. One of the great advantages of telpherage is that the material can be deposited exactly where wanted, thereby effecting great economy in handling.

Telpherage may be divided into four great classes, but most of the regulating, controlling, starting and stopping devices are applicable to all the systems. These four divisions or classes consist of, first, electric aerial cableways; second, electric tubular despatch (surface or underground); third, electric overhead tramrails; and fourth, electric automatic narrow gauge (overhead, surface or underground). In all cases the motive power is electricity, and the systems are automatic.

As to aerial cableways and the commercial, practical use of wire cables for suspended cars, there are at present some twenty-five manufacturers furnishing mechanical cableways, and one manufacturer alone has more than a thousand lines in operation, some of which are twenty miles in length. Most of these are operated on the system of using one cable for the track, the carriers being drawn by another cable. This system has great disadvantages of not being able to pass around curves and in requiring additional stations every few miles—in addition there being the friction of the rollers and devices for handling the long moving cable. This system, however, demonstrates the claim that even with such drawbacks the total operating expenses per ton-mile are less than by any other method of light transportation.

It is evident that with the telpherage system, rivers, ravines, swamps and inequalities of the ground are no obstacle to direct transportation. Over level plains, where there are no difficulties or obstacles, especially for the transportation of lighter material, the first low cost of installation and operation commends telpherage.

The size of the cable varies according to the loads to be carried. The operation is free from surface obstructions, such as snow, washouts or wrecks. The rapidity of operation, which depends on the speed of the electric car, is only limited within reason by the cost of construction. The length of the line from each station is only bounded by the commercial possibilities of electrical transmission. Curves are no more a disadvantage than on surface electric railways, and the direction of route may be changed as often as desired to avoid excessive grades and thereby cheapen the cost of construction.

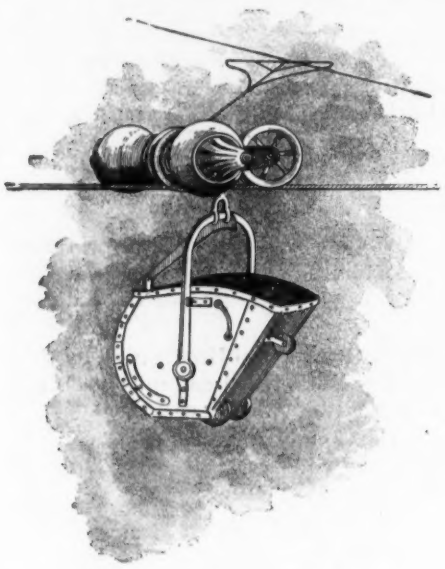


FIG. 2.—TELPHER WITH ORE OR COAL BUCKET.

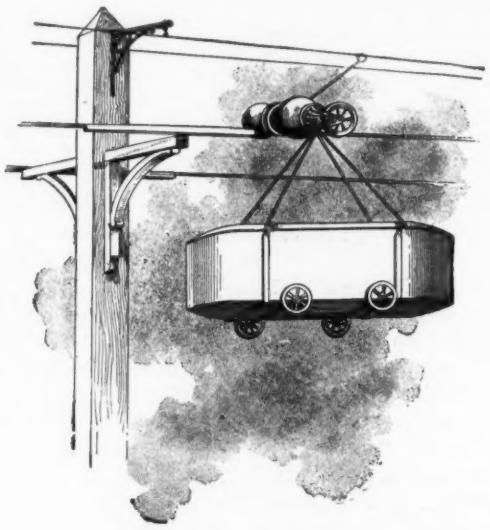


FIG. 3.—OVERHEAD MAIL AND EXPRESS CARRIER FOR TRANSFER TO SURFACE OR UNDERGROUND.

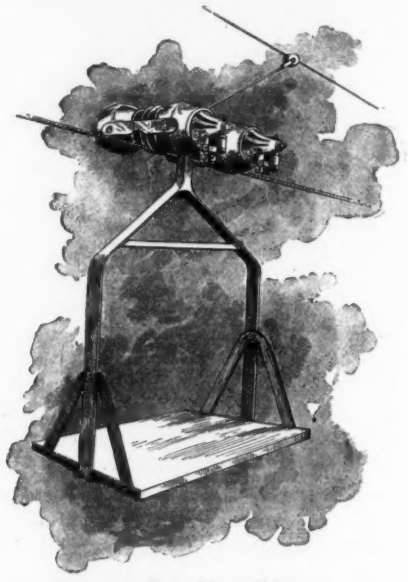


FIG. 4.—TELPHER WITH PLATFORM CAR.

In summing up, it may be said that the cost in every respect is remarkably low. The appearance is pleasing and artistic, the durability is certain, and the manufacture and erection is speedy. The whole arrangement is simple, the repairs are slight and little ground is occupied.

The Consolidated Telpherage Company, of 20 Broad Street, New York, has recently developed what is termed the unit telpherage system and with electricity as the motive power. This company has now a commercially-developed system, some features of which are illus-

trated in the accompanying illustrations. This company is under the management of Mr. H. McL. Harding, who in the telpherage field is only continuing his work of electric transportation. The company is no wprepared to furnish telphers, both trucks and cars, and to contract to erect lines—in short, to furnish complete operating plants, and particularly for the transportation of mail, express and other light material.

It goes without saying that those connected with existing light or railway plants have exceptional facilities for installing and operating telpherage lines. The cost of line and rolling stock is claimed to be small and the power which is required can be rented from existing lighting or railway plants.

Electrically-Driven Jet Condenser.

There was lately installed at the United States Government Yard, Bremerton, Washington, an electric plant which includes a direct-connected, electrically-operated jet condenser, furnished by the Stilwell-Bierce & Smith-Vaile Company. As will be seen from the accompanying engraving, a subbase is provided extending under the air cylinder as well as condensing chamber, and also extended to receive a G. E. motor. The power end is provided with double-reduction gears; the motor has a rawhide pinion, and there is also a rawhide pinion on the pinion shaft of the condenser. The gears are machine cut. The air cylinders are removable and brass lined, and the air piston is of bronze, fibrous packed and provided with an expansion ring. A special priming valve is also provided, and the condensing chamber is fitted with a special distributing valve.

ELECTRICALLY-DRIVEN JET CONDENSER.

"Commercial" Engine-Type Generators.

The generators herewith illustrated have a frame of cast steel which affords protection to the magnet coils and armature, yet does not obstruct the ventilation; as a consequence cool running is claimed to be a feature attained in these machines to a high degree.

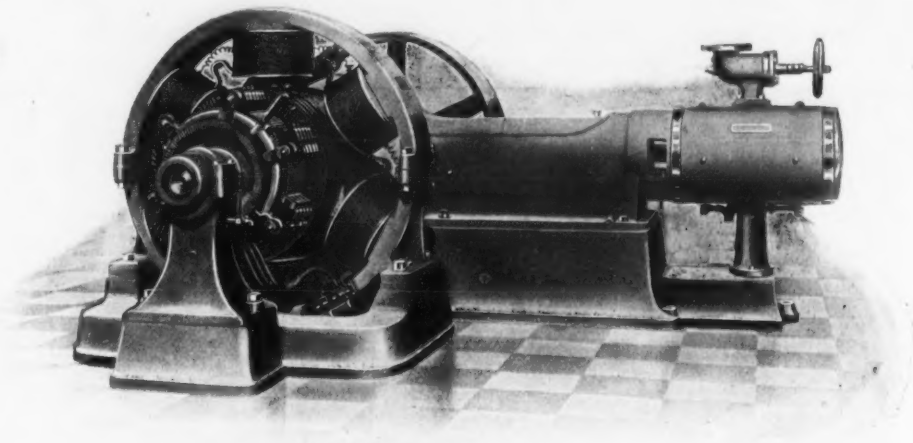


FIG. 1.—DIRECT-CONNECTED "COMMERCIAL" GENERATOR.

—less than 1 per cent of the output being required to magnetize the field of a 75-kw machine.

The armature is of the ironclad type with the well-known barrel winding by the employment of which the fewest possible number of joints and bends are made in the conductors, and mechanical rigidity and good ventilation are secured. The conductors are rectangular copper bars, formed into coils and insulated, and an additional insulation is applied to the slot; each coil tested as it is put in place, thus giving surety against grounds. The windings are so proportioned that the magnetic field is relatively strong compared with the armature magnetization, and the pole-pieces so shaped, and the armature teeth worked at such a density, that the crowding of the field to one side of the pole under load does not occur, and a fixed neutral point with perfect commutation thus secured. Mechanical solidity of the armature is secured by the use of complete disks punched in one piece from extra large sheets for each lamination, instead of sections of disks, the use of which is a weak point in the construction of many large armatures. The iron is carefully selected and tested for its hysteretic qualities.

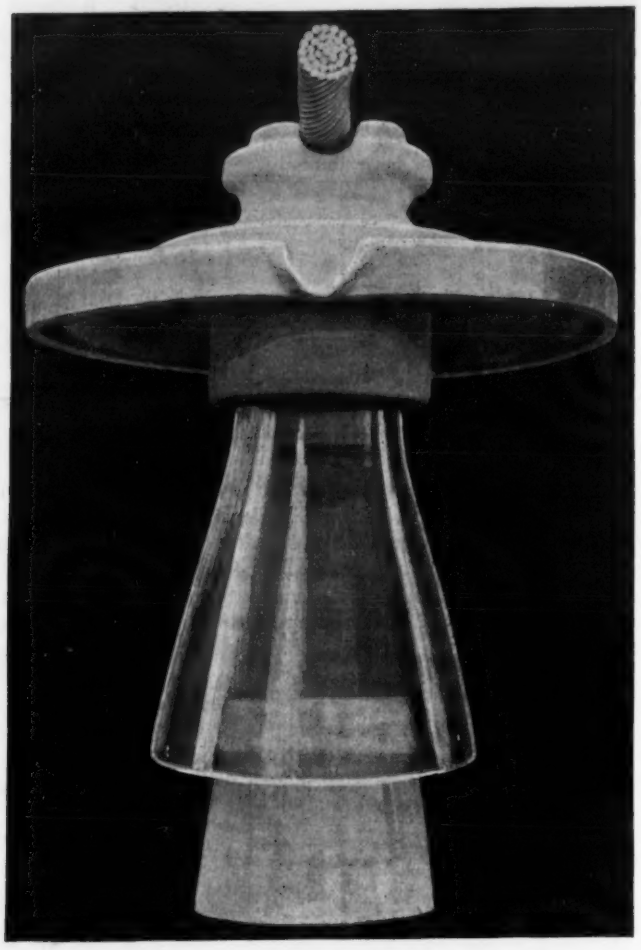
FIG. 2.—ARMATURE OF "COMMERCIAL" GENERATOR.

The field coils are wound on spools, by which they are protected from injury, and are made removable. The field cores are of circular cross-section, giving the smallest possible length of a turn of the field coils, and combined with pole shoes to distribute the magnetic flux in the air-gap, thus giving a magnetic circuit of the highest efficiency

The commutator is of large size and carbon brushes are used throughout. The company's new brush holder with flexible conductors connected to each carbon is used exclusively. The manufacturers of the machines illustrated are the Commercial Electric Company, Indianapolis, Ind.

Insulator for High Electrical Pressures.

The insulator illustrated herewith represents the type being supplied in large quantities to the Standard Electric Company in California by Mr. Fred M. Locke, Victor, N. Y. These insulators are for use on a line 200 miles long, carrying a pressure of 60,000 volts. The insulator is made of brown china with a glass or porcelain centre extending down around the pin. It is 10½ ins. in diameter and about 15 ins. from the top of the cross-arm to the aluminum line wire. It



HIGH-PRESSURE INSULATOR.

weighs about 12 lbs., and was subjected to a standard salt water test of about 120,000 volts. The beveled trough on the periphery catches all the water shed from the upper surface, and spouts it off to one side of the arm. The surface leakage in wet weather is said to be not over one-eighth watt. The insulator is mounted on a wooden pin with a porcelain sleeve, as shown.

Two New Types of Motor-Driven Presses.

The accompanying cuts show two new types of motor-driven presses which are interesting as illustrating the methods by which motors are now being attached to power presses, and giving an idea of how totally unlike the usual presses are those driven by electric motors.

The electric system of power is now finding much favor with many press users, and more particularly where the press is the only power-driven machine in operation. This was the case in the two factories to which the machines illustrated were sent. After considering nearly every means of power, the electric motor was found to be the most economical, the most compact, the most easily applied, and the most cleanly. In the cases mentioned, it was impractical to have an engine, and it was an easy matter to run electric wires into the building.

The direct-geared press shown in Fig. 1 is a brass founder's sprue cutter. This press is a modification of the well-known "Stiles" power punching press, and this same method of applying power is, of course, also applicable to the regular machine. The sprue cutter is specially designed to meet the requirements of brass founders and manufacturers of other soft metal castings.

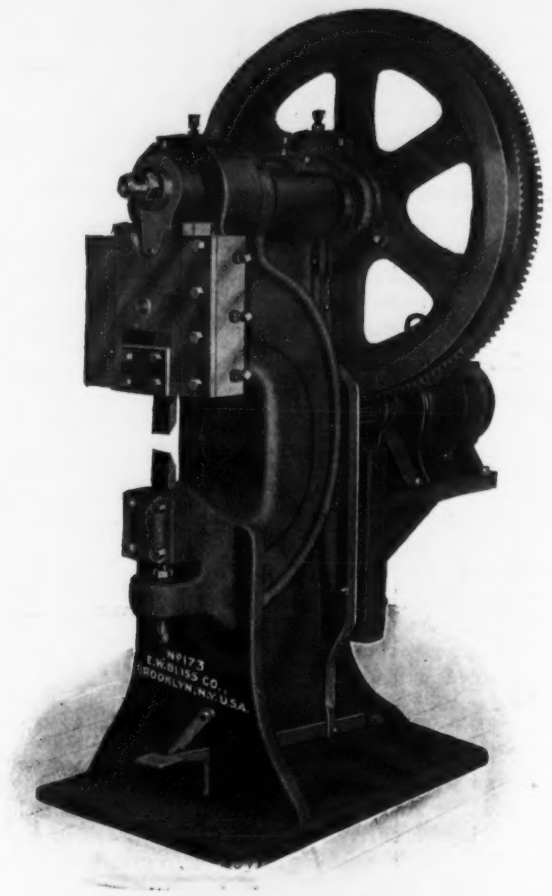


FIG. 1.—DIRECT GEARED PRESS.

FIG. 2.—BELT-DRIVEN PRESS.

The belt-driven press, Fig. 2, shows the rear view of the machine. This press is adapted for cutting and forming parts of electrical in-

struments, hardware, sewing machine and typewriter parts. These two presses have recently been built by E. W. Bliss Company, 12 Adams Street, Brooklyn, N. Y.

The Taylor Sleeve Gate Turbine Water Wheel.

The accompanying cuts represent several styles of the Taylor sleeve gate turbine water wheel, invented and patented by John Williams Taylor, a mechanical engineer well known in his profession, and who recently organized the Taylor Manufacturing Company, at Lynchburg, Va., of which he is the general manager.

The Taylor water wheel is made in twenty-three sizes, both right and left hand, and in all styles of settings for both horizontal and vertical shafts. The diameters range from 15 inches to 68 inches, the 15-inch diameter wheel being made in six different depths of buckets, so as to accommodate very small powers under high heads. The makers of this wheel consider that it has been demonstrated by practical experience that turbine wheels of smaller dimensions than 15 inches are of little commercial value when placed under high heads; the arc of contact for belts or gears is so small and the speed of wheel so great that as a motive power they are anything but satisfactory, as has been proved in the use of very small turbine wheels under heads of from 25 to 100 feet. The diameters of the Taylor sleeve gate wheel are the top diameters of the runners, and not the bore of the band, as is taken by some manufacturers as a basis for rating diameter.

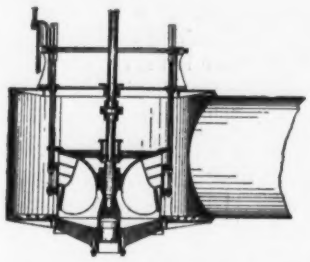


FIG. 1.—SECTION OF WHEEL.

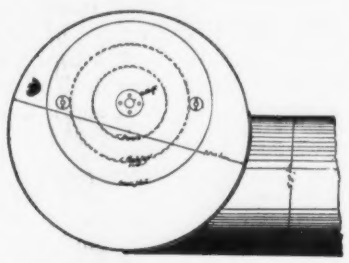


FIG. 2.—PLAN OF VERTICAL SCROLL FLUME.

Some of the features of the Taylor turbine are brought out in Fig. 1, showing a section through the wheel proper. The adjustable step pot under the wheel allows the step and step-shoe to be removed without interfering with wheel or casing. The cone-shaped runner allows the chute-box to overhang the runner at every point, while the close proximity of the runner to the chute-blade, not more than ¼-in. to ⅝-in. space being left between runner and chute-blade, insures a perfect guide for the water to the runner at all stages of gate opening. The gate of the wheel is an outside close-fitting sleeve around the chute-box, opening downward and closing upward, thereby applying water to the extreme upper part of the runner at partial gate, and thus insuring good efficiency. The gate being thin on top has but little pressure on it other than its own weight, and being well counterbalanced, makes a sensitive, easy-working gate under all conditions of variable loads.

The webbed chute-box is another feature of the Taylor wheel which will be appreciated by the engineer, as it gives three tiers of long stationary chutes around the wheel, thereby providing long positive water courses. It will be noted that at one-third gate the water all enters the runner through the upper tier of chutes, and at two-thirds gate through the upper and middle tier. This particular type of chute-box is adhered to wherever wheels are designed for steady loads; but where the load is variable, as in electric plants, the chutes and webs are placed differentially or staggered so that there will be no dead points.

The dished crown-plate on top of the chute-box places the pedestal and collar close down to the runner, holding the same in perfect alignment. The intermediate cylinder or chamber between the chute-box and the base ring answers the double purpose of accommodating the sleeve gate when opening, and forming a housing for the lower end of the runner.

The type of runner used is of the downward and outward flow type, now employed generally by all manufacturers of cylinder gate wheels. The intermediate chamber above referred to is of striking benefit in confining the water to its proper course through the runner until it reaches the discharge end. This intermediate cylinder is particularly valuable when the wheels are placed on a horizontal shaft, as it prevents the runners from projecting into quarter-turns and getting outward discharge before the water reaches the extreme discharge end of bucket.

Pressed steel buckets are used exclusively instead of bucket patterns; the dies employed are cast and cut true to the minutest curve of the bucket. The buckets are cut from open-hearth flange steel of 60,000 pounds tensile strength, placed in a furnace and heated to a bright red, then placed in the die and the follow block pressed in, thus forming the bucket under 2000 pounds pressure per square inch. The temperature is reduced before the buckets are removed. The buckets thus made one by one are afterwards set on to the disc or hub pattern and cast to the disc and band, the latter binding the discharge end of runner. Turbine runners thus formed have a tensile strength three times the strength of those where all cast iron is used.

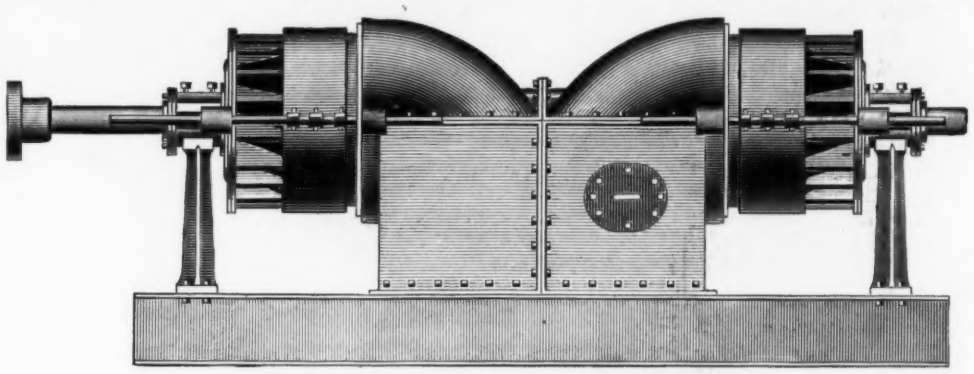


FIG. 3.—PAIR OF HORIZONTAL DISCHARGE TURBINES.

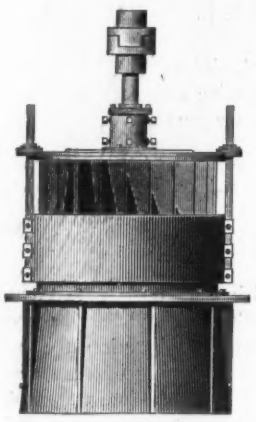


FIG. 4.—PLAIN VERTICAL WHEEL.

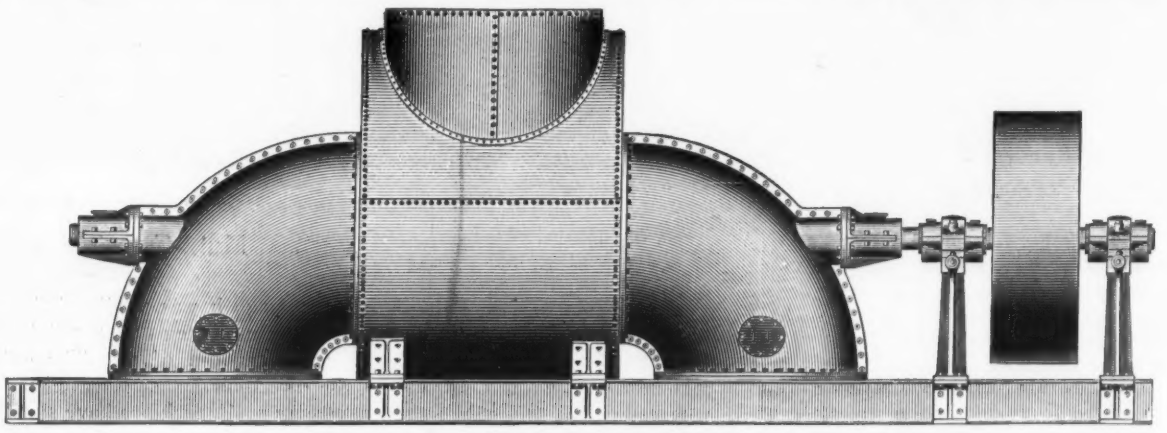


FIG. 5.—PAIR OF HORIZONTAL DOUBLE-DISCHARGE, IRON-CASED TURBINES.

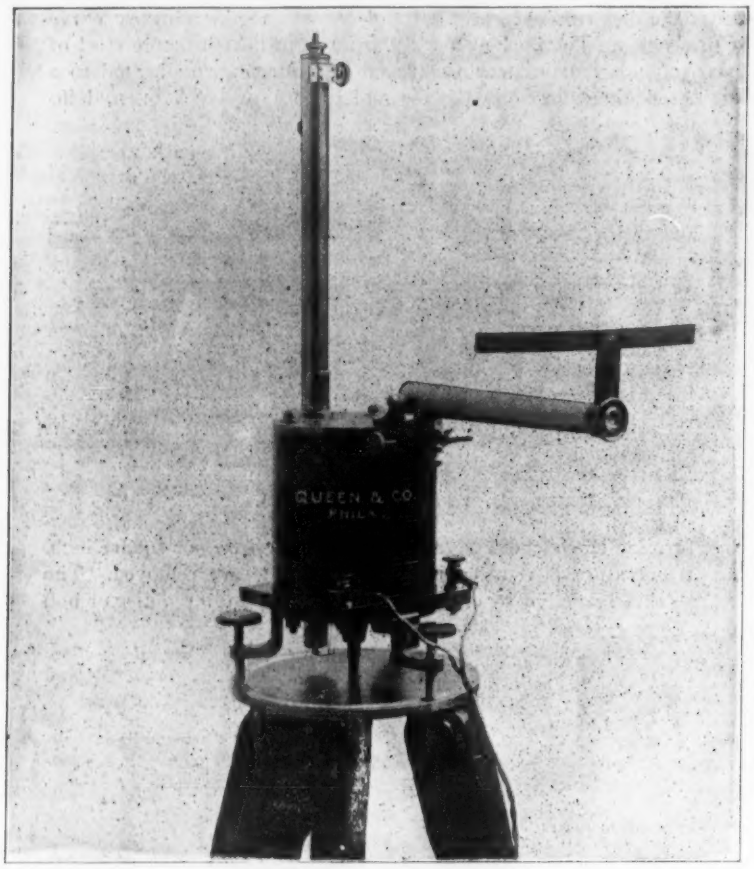
The outside sleeve gate on the horizontal shaft can best be appreciated by reference to Fig. 5. The gates are suspended entirely on rods supported by outside bushed bearings, taking the weight of gate entirely from the chute-box, and thereby reducing friction of the gates 50 per cent.

Another feature of the Taylor wheel is that with it no racks, pinions or segments in water are employed. All of the gate work on vertical wheels is above the water line, and the gates are controlled either by racks and pinions or by heavy counter-balanced rockers and sector gears. On horizontal shafts all gate moving devices are placed on the outside of the flume, consisting of crossheads, bored guides, connecting rods, counter-balanced rocker arms, sector gears, master wheels, etc.

A New Galvanometer.

A modified and compact form of high sensibility D'Arsonval galvanometer has recently been brought out by Queen & Company, of Philadelphia. This instrument was designed particularly for work in measuring the resistance of lines and cables where compactness, portability and highest sensibility were required. It will be seen from the accompanying illustration that the telescope which carries the scale is attached directly to the magnet base, and although the scale is only 4 ins. in length, the optical parts are so designed that the same effect is secured as if a millimeter scale at meter distance from the mirror were employed.

The movable coil is enclosed completely in a tube, thereby being unaffected by air currents, and by having a number of such interchangeable tubes with different resistances, the galvanometer becomes applicable to a wide range of work. The coil is clamped for transportation and released for use by merely turning the small screw at the top of the tube. The illustration shows the galvanometer on a tripod arranged for work in the street. Actual tests made with this galvanometer in the street with heavy wagons passing, showed that it is but little affected by such vibrations and can be used to give reliable indications under these extreme conditions.



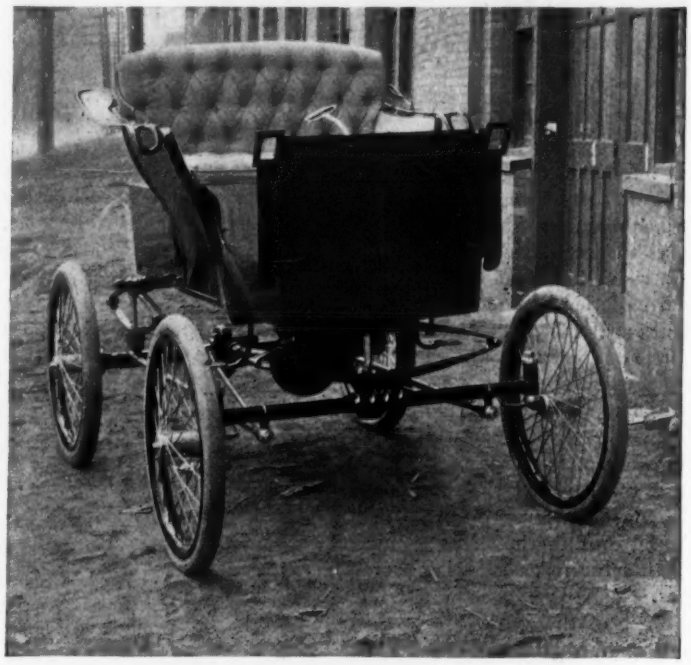
NEW GALVANOMETER.

The sensibility can be made about 2000 megohms per volt, and the motion of the coil made either dead-beat or ballistic, as desired. It is provided with a well-finished carrying case, which is also arranged to hold any extra tubes. The galvanometer was particularly designed to accompany Queen & Company's new portable cable testing outfit, but the instrument is also peculiarly adapted to a great many other lines of work.

Century Electric Stanhope.

The electric vehicle shown herewith, made by the Century Motor Vehicle Company, Syracuse, N. Y., is steered and the speed controlled by means of one starting lever. The vehicle is propelled by a pair of bevel gears on the rear axle, and the motor is suspended from the body toward the front end. A double reduction system of gearing is used, there being a pair of spur gears at the motor end of the gear shaft in addition to the bevel gears on the rear axle. A mechanical brake is used, operated by foot lever.

The frame is constructed of seamless steel tubing and forgings, ball bearings being used throughout. The frame is flexible, to allow for inequalities in the road. The entire driving mechanism or power transmission is enclosed, and is dust proof. The battery consists of



CENTURY STANHOPE.

42 cells, which are arranged in six trays, and the battery connections to the controller allow of three speeds forward, three backward and the stopping point, which is also the charging position.

The wagon gear (or frame and wheels) is made by the Century Company from its own designs, and is one of its special features. The motor used in the electric vehicle is also specially made from its own designs. The motor controller is made in the Century factory, being a very simple and efficient arrangement of knife switches, which do not "arc" when the speed is changed. The majority of the vehicles made by this company are fitted with wire wheels and pneumatic tires, although in special cases delivery wagons are fitted with wooden wheels and solid rubber tires.

Multi-Circuit Arc Dynamo.

A few years ago it was predicted that, with the improvements in alternating-current systems of arc lighting, the old style series arc machine would go out of use. The only serious objection to the use of the direct-current series arc machines appears to have been that heretofore such machines have supplied but a single circuit, and thus the kilowatt capacity has been restricted by the limitations of line voltage; and as 7000 volts is considered the maximum for commercial work, such machines have been able to supply only 100 six-ampere enclosed arc lamps, thus limiting the machines for such enclosed lamps to capacities not much over 40 kilowatts.

It has been recognized for years that a solution to the direct-

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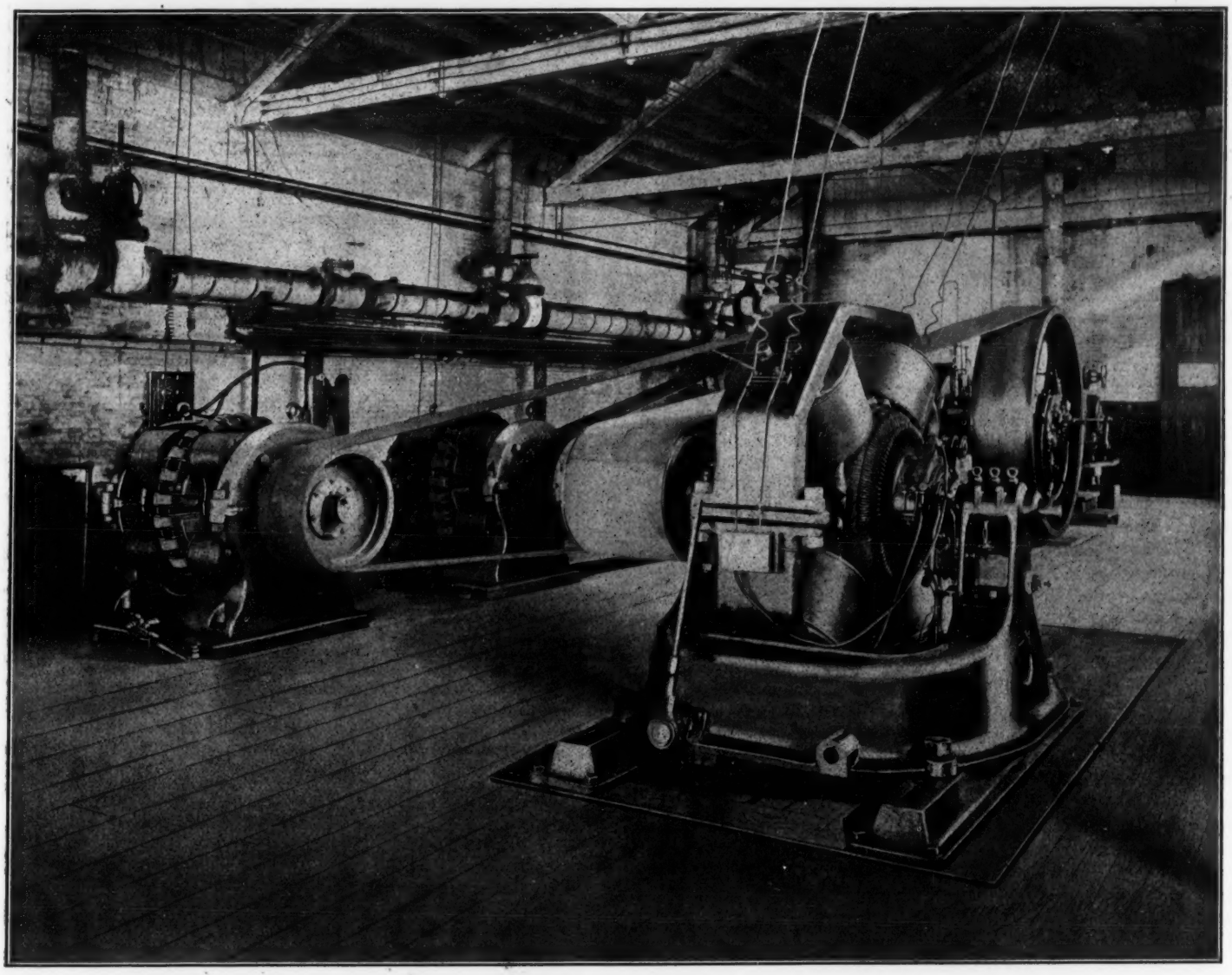
current arc problem would be found if a large generator could be built that would supply a number of separate and independently regulable circuits. It is true that one well-known type of machine is arranged with three separate commutators and with the lamps divided in groups between the commutators. In this case, however, everything is still in series, and the total voltage on open circuit remains practically the same as when all the lamps are in single circuit.

Among those who have worked on this problem for years is Mr. S. W. Rushmore, of the Rushmore Dynamo Works, Jersey City, who nearly eight years ago produced a successful multi-circuit machine, and descriptions of a test of a 20-light two-circuit machine built by him were published in these columns some years ago. Since that time Mr. Rushmore has continued his experiments with the able assistance of his chief engineer, Mr. R. T. Kingsford, and his company is now building a complete line of multi-circuit arc dynamos in sizes from 200 to 500 lights capacity on any number of completely independent circuits, for belt or direct driving.



VIEW OF A MULTI-CIRCUIT ARC DYNAMO IN ACTUAL OPERATION.

The illustration herewith shows a Rushmore multi-circuit arc machine that has been in constant service for nearly a year in the station of the People's Light & Power Company at Jersey City, N. J. This machine runs at 500 r. p. m. and carries two independent circuits of 133 lights each, or a total of 266 9.6-ampere 50-volt open-arc lamps. It has carried as high as 140 lights per circuit, but such loads are unusual at the station.

The machine is driven by a 500-hp McIntosh & Seymour tandem-compound engine, to the other flywheel of which is belted two 125-light Brush single-circuit machines

The Rushmore has been found entirely reliable in operation. Either circuit may be abruptly open-circuited or short-circuited under any load without the least effect upon the other circuit. It runs practically without sparking, and the commutator has received no attention since the machine was installed.

The machine is of very simple construction, having a simple four-pole field and an ordinary Gramme ring armature and simple commutator. Each pair of poles, the section of armature thereunder and the corresponding pair of brushes constitute, as it were, a separate series machine, the current leading from one brush to a line circuit, through two of the field coils, through the other brush of the pair, and dividing through the armature winding to the first named brush. Each pair of brushes is carried upon a separate quadrant rocker, and the regulation is effected by shifting the separate rockers. For each rocker there is a small oil pressure cylinder, and oil is admitted under pressure to one end or the other by a small magnet-controlled valve, and thus each pair of brushes occupies, at all times, a position on the commutator corresponding to the line voltage required. All regulating mechanism is contained in a small tank in the base of the machine, which also contains a small rotary oil pump belted to the armature shaft, to supply oil at the needed pressure.

The machine in the illustration occupies about the same space as one of the single-circuit machines shown, and it is stated that recent tests show that the machine has an efficiency of over 90 per cent at full load, which is in excess of that claimed by makers of the old single-circuit machines.

The field consumes but 380 watts, and as the armature runs very cool, it is evident that there is not much power lost. It is confidently believed by the makers that this type machine will soon supersede all others makes for arc lighting. They have spent several years in protecting their inventions by patents and in acquiring the patents of others bearing upon the subject, thus thoroughly covering the system.

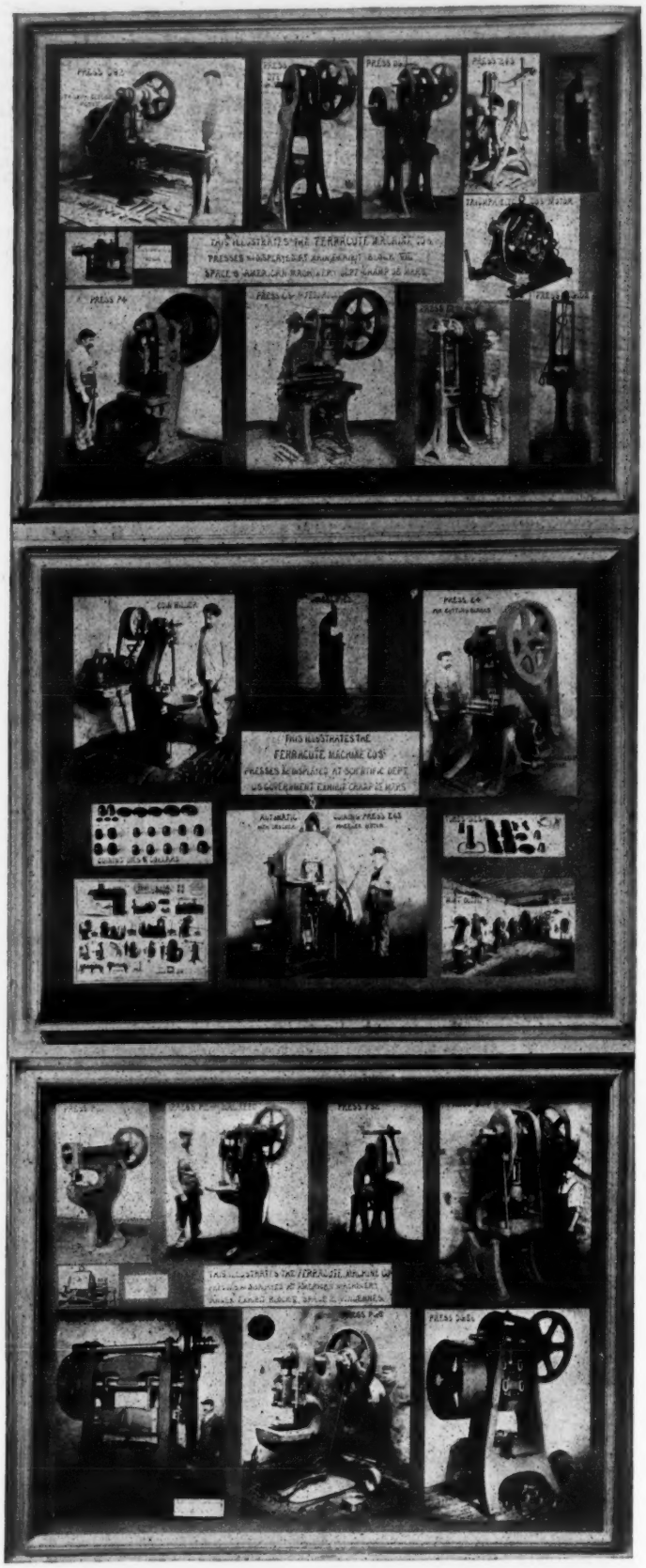
Ferracute Company Exhibit.

In the first of the accompanying groups of views are shown nine presses, together with the motors for driving them, forming an exhibit of the Ferracute Machine Company at the Paris Exposition, the location being Block 8, in the Champ de Mars. This exhibit enjoys the distinction of being the first American one set up complete ready for inspection.

The first of these pictures is an armature-disc notching machine of recently improved construction. The second is a single-action redrawing press of medium size, used for a variety of metal work, especially where rather long strokes are required. The third is a double-action geared drawing press, intended for cuplike work of all sorts, where the blank cut from the sheet is held from wrinkling by the action of the main ram, which stops and dwells upon the metal, holding it under great pressure, while the plunger descends through it, and draws the work to shape. The next picture is an inclinable foot press, suitable for light work, such as fruit cans, etc., and the final picture in the top row is a small, low-priced pendulum foot press for very light work, such as buttons, jewelry, steel pens, etc. The first picture in the lower row is a medium-sized punching press, being one of six sizes of the same design. The next picture is an inclinable cutting press, arranged with single feed rolls. The third picture in the lower row is the smallest size of a series of five embossing presses of the same design, and used for heavy work, where great stiffness can be obtained on account of the straight columns, placed near together. The last picture of this group is a small drop press, arranged for the ram to be elevated by either foot or hand.

The second group shows another exhibit of the Ferracute Machine Company, in the United States Government Department, in the Champ de Mars, intended especially for making coins and medals. The first machine is a newly-designed coin miller for thickening and rounding the edges of blanks, which are cut from the flat sheet. This machine has an indexing table which can instantly be thrown around to any one of three different positions, so that different sizes of planchets can be made in the various tubes provided. The feeding consists simply of placing the blanks in the tube as fast as they can be handled, the machine doing the rest, and turning out from 200 to 400 pieces per minute, when using only one tube. It can, however, be run with three operators, using all the tubes at once, if desired. The next machine shown is a small foot press, intended for punching holes in medals for stringing them upon ribbon, etc. The third machine is an improved cutting press, with double feed rolls, for cutting one or more blanks at a time, from a strip which is automatically fed through, the operation in this machine really preceding the coin miller above referred to. The lower central machine is an improved automatic coining press, equipped with dies for making small medals at the rate of 100 per minute, from the planchets produced in the coin miller. This machine has a number of improvements heretofore not incorporated in presses of this kind. Among them is an arrangement for instantly raising the upper die, without throwing either die out of adjustment, so that its face can be examined and cleaned, as can the face of the lower die. Other improvements are the lower toggles, to prevent lost motion, and keep oil and dirt from running down from the dies. Another is the extremely short stroke of the ram, and the feeder, enabling the machine to be run at a high speed, without much noise and jar. It will be noticed that all the machines in question are run with individual motors mounted directly upon them.

The third group of seven presses shows another Paris exhibit of the Ferracute Machine Company, which is located in the Machinery Annex at Vincennes, Block V, Space 2. The first machine is a deep-throated punching press. The second is an ordinary punching press, equipped with an improved dial feed. The third is an inclinable screw press. The fourth is a single-action inclinable redrawing press. The fifth is an improved double-crank press with friction clutch. The



VIEWS OF THE EXHIBIT OF THE FERRACUTE COMPANY AT THE PARIS EXPOSITION.

sixth is a large-sized geared punching press. The seventh is a large double-action straight-sided drawing press. Some of these machines are equipped individually with electric motors, while others are run by electricity on the group system.

NEWS OF THE WEEK.

Financial Intelligence.

THE WEEK IN WALL STREET.—The changes in Saturday's bank statement were more limited in amounts than they have been in many weeks. The change in actual cash was a decrease of only $1,123,000 and the loan account showed a decrease of only $287,000. In consequence of the changes in deposits and in actual cash, surplus reserves decreased only $645,000, and the banks still held $15,333,457 in excess of the lawful requirements. The showing made by the banks was generally construed as a strong one, and the publication of the figures was followed by quite a sharp rally in the stock market, which, however, still left the trading showing its previous feverish and uncertain tone. Money continues to be ample for all requirements. Call money ranged between 2 and 3. The rates for time money are 3 per cent for short and 3½@4 per cent for four to six months' arrangements. Commercial paper is in moderate supply, the rates being 3¼@3¾ per cent for double names. In the stock market the result of the week's dealings was lower prices, there being practically no exceptions. Irregularity prevailed all week in quotations, and speculation was exceedingly dull, bordering, at times, on a condition approaching demoralization. Speculation was almost entirely confined to professional interests, this element having become, in the main, bearish in sentiment. In the industrials there was considerable irregularity. American Steel and Wire common sold down to 36½, and the preferred to 76. Weakness characterized the electrical stock market, all, with one exception, closing with net losses. General Electric closed at 133, the net loss for the week being 4 points; the sales amounted to 3705 shares. Western Union shares to the number of 23,309 were traded in, the stock closing at 79⅜, a net loss of 2½ points since the week previous. Brooklyn Rapid Transit closed at 68⅛, the sales being 74,860; the net change in the week's quotations was a loss of 5⅝ points. Metropolitan Street Railway closed with a net loss of 6¾ points on the week's business, the closing figure being 148½. The sales were 19,951 shares. Erie Telegraph and Telephone closed on the New York market at 106⅞, a net gain of 3⅜. In the curb market prices were irregular, several further declines being noted, only in a few cases was there recovery from the low prices of the previous week. Among the industrial stocks some issues showed decided strength and closed the week with substantial net gains. The strike in St. Louis unfavorably affected the United Railways of St. Louis securities, but later in the week these issues regained their early loss. They closed firm and dull. Among the net losses in outside list are these: Electric Boat, 3; do., pfd., 1; Otis Elevator, 2¼, and Worthington Pump pfd., 1. The closing quotations were as follows: Electric Boat, 17; do., pfd., 45 asked; Electric Vehicle, 28; do., pfd., 75; General Carriage, 9¼; Illinois Electric Vehicle, 1½; New England Elec. Transp., 4; New York Elec. Vehicle Transp., 8¼; Telephone, Telegraph and Cable of America, 5; Otis Elevator, 28; Worthington Pump, 108. Philadelphia closing quotations were: Electric Storage Bat. Co., 70; do., pfd., 80; Electric Co. of America, 8½; Gen'l Elec. Automobile, ⅞. The losses for the week ranged from ⅛ to 3 points, the general tendency of the Philadelphia market all week being toward lower prices. In Boston, Bell Telephone closed the week heavy, at 305; Erie Telephone, 103. In the list of inactive stocks dealt in on the New York market the following closing quotations are recorded: American Dist. Tel., 26; American Tel. Co., 90; Commercial Cable, 160; New York & N. J. Telephone, 170; Hudson River Telephone, 120.

NEW ENGLAND TELEPHONE.—The stockholders of the New England Telephone & Telegraph Company held a special meeting in New York last week and approved an increase in the authorized capital stock of the company from $15,000,000 to $20,000,000. This increased capital will be used from time to time to meet the demands of the business in the way of new extensions. The company expends on an average $1,500,000 per year in the extension of its business, and in the past new money has been derived by the sale of both bonds and stock. During 1899 the company issued $1,783,000 of new stock, of which $983,000 was used for new construction and $800,000 for account of the Southern Massachusetts Telephone Company. One million-dollar 4 per cent debenture bonds were also issued, of which part were used to redeem $500,000 6 per cent bonds and the balance in new construction. The company has filed notice at Albany of the increase of its capital stock from $15,000,000 to $20,000,000.

COMMERCIAL CABLE COMPANY.—The Commercial Cable Company has filed with the commissioner of corporations in Boston, Mass., the following certificate of condition of Dec. 31, 1899:

Assets:

Cables and buildings	$30,129,670
Spare cables and supplies	731,856
Patent rights	1,195
Stocks and bonds	3,104,295
Debts receivable	1,196,472
Total	$35,163,488

Liabilities.

Capital stock	$10,000,000
Debts	18,853,374
Reserves	3,832,051
Bal. profit and loss	228,063
Revenue applied to extensions	2,250,000
Total	$35,163,488

THIRD AVENUE BONDS APPROVED.—At the stockholders' meeting of the Third Avenue Railroad Company on April 11 the proposition to issue a mortgage on the property and franchises of the road to the Morton Trust Company, as trustee, for the purpose of securing bonds to the amount of $50,000,000, was ratified without a dissenting vote. Another meeting of the stockholders of the company was held on Thursday for the purpose of approving and authorizing the lease of the three surface railroads of the Third Avenue Company to the Metropolitan Street Railway Company, and the contract embodying such lease and the guaranty of certain bonds of the company by the Metropolitan. The Metropolitan stockholders also met on Thursday for the purpose of ratifying an additional $7,000,000 stock issue. It is expected that the Third Avenue will become a part of the Metropolitan before June 1.

GENERAL ELECTRIC'S ANNUAL MEETING.—The annual meeting of the General Electric Company was held at Schenectady, N. Y., on May 8. Of the 200,000 shares issued by the company, 140,000 were voted. The following-named gentlemen were elected directors: Gordon Abbott, Oliver Ames, C. A. Coffin, T. Jefferson Coolidge, jr., Thomas A. Edison, George P. Gardner, Eugene Griffin, Henry L. Higginson, J. Pierpont Morgan, Joseph P. Ord, Robert Treat Paine, 2d, George Foster Peabody and Charles Steele. The annual report of this company was published in our issue of April 28.

DIVIDENDS.—The Pacific Auxiliary Fire Alarm Telegraph Company, San Francisco, recently declared dividend No. 28, of five cents per share of the capital stock of the company, payable May 14. The Mutual Electric Light Company, San Francisco, has declared a dividend of eight cents per share on its capital stock, payable on and after May 11.

THE NATIONAL TUBE COMPANY.—The report of the National Tube Company for the six months ending Dec. 31, 1899, shows surplus earnings of $6,511,510, after deducting two dividends of 1¾ per cent on the preferred stock.

Commercial Intelligence.

THE WEEK IN TRADE.—Inactivity in demand and weakness in prices were the principal features of the trade situation last week. Bradstreet's reports that iron and steel buyers are still holding off, most of the business done being for small lots for immediate consumption. Further declines are noted in steel billets and for some finished products, while sympathetic weakness is reported in the other metals, such as copper, lead and tin. There was a slight increase of the output of pig iron during the month of April, and a small gain in furnace and other stocks. Steel rails and structural material are conspicuous exceptions to the weakness above noted,

prices for these products being firmly maintained. Relatively the best trade reports come from the Pacific coast. In Chicago there is a good export inquiry for rails; in St. Louis retail business is greatly affected by the strike of street railway employees. In the east business is reported quiet in wholesale lines. Anthracite coal is weaker at Philadelphia. Business failures for the week, as reported by Bradstreet's, number 174, as compared with 153 last week, 169 in this week a year ago, 250 in 1898, 251 in 1897, and 265 in 1896. In the metal market copper is quoted ⅛c. lower than it has been for the past six weeks. The following quotations are posted at the Metal Exchange: Lake Superior ingot, 16⅞ cents; Electrolytic, 16¾ @16⅞ cents; Casting stock, 16⅝@16¾ cents. Business in copper is slow.

EXPORTS OF ELECTRICAL MATERIAL.—The following were the exports of electrical material from the port of New York, for the week ended May 12: Brazil—332 packages electrical material, $13,704. Antwerp—37 packages electrical material, $3,688. British East Indies—9 cases electrical material, $460. British West Indies—16 packages electrical material, $1,829. Barcelona—2 cases electrical machinery, $96; 5 cases electrical material, $143. British Australia—49 cases electrical material, $2,739; 549 packages electrical machinery, $59,250. Cuba—11 cases electrical material, $489. China—12 cases electrical machinery, $875; 27 packages electrical material, $3,292. Central America—18 cases electrical material, $230. Frienne—5 cases electrical machinery, $773. French Possessions in Africa—6 packages electrical material, $289. Hull—6 packages electrical material, $450. Hong Kong—45 packages electrical material, $3,000. Havre—194 packages electrical material, $10,226; 2 cases motors, $800. Japan—3 packages electrical material, $65. London—21 packages electrical material, $1,749. Liverpool—212 packages electrical material, $28,824. Mexico—167 packages electrical material, $3,775. Marseilles—50 packages electrical material, $300. Newfoundland—4 cases electrical material, $33. Nova Scotia—3 cases electrical material, $60. New Zealand—3 cases electrical material, $105. Porto Rico—4 packages electrical material, $980. Peru—36 packages electrical material, $2,377. Southampton—8 cases electrical material, $2,619; 80 cases electrical machinery, $1,118. St. Petersburg—8 packages electrical material, $250. Tasmania—5 cases electrical material, $400. U. S. Colombia—3 cases electrical material, $123; 1 case electrical machinery, $250. Venezuela—50 packages electrical material, $919.

GROWTH OF OUR EXPORT TRADE.—The growth in exportation of manufactures continues to be the most striking feature of the export trade of the United States, which in the nine months ending with March, 1900, reached the sum of $1,053,820,680. Of this large exportation, more than 30 per cent was manufactures, against 26 per cent in the corresponding months of the fiscal year 1899 and 23 per cent during the same months of the fiscal year 1898. For the month of March alone the exports of manufactures amounted to $44,767,139, which is far greater than the total for any preceding month in our history. For the nine months ending with March, 1900, the exports of manufactures were $313,278,668, against $163,187,935 for the nine months ending with March, 1896, the total for the entire period having thus nearly doubled in that time. For the full fiscal year it now seems probable that the total exports of manufactures will considerably exceed $400,000,000, while the total for the fiscal year 1899 was $338,675,558; for 1897, $277,285,391, and for 1895, but $183,595,743.

CHINA'S FOREIGN TRADE.—A communication received by the Treasury Bureau of Statistics from the Imperial Maritime Customs Service of China gives some interesting facts concerning China's foreign trade, especially her trade with the United States, which developed very rapidly last year. Referring to the effect of the new railway lines, the report says that Newchwang and Tietsin have promptly responded to the stimulus of better means of communication. It is found that immediately trains begin to run, districts through which there was little traffic, such as between Paoting and Pekin, suddenly commence to hum with life and activity, and there springs up a flourishing trade which was formerly undreamt of and impossible, for want of cheap transport. In view of the fact that railways are now opening up districts previously cut off from communication with ports, it is fairly safe to predict that in less than another ten years the trade will have again doubled. These improved facilities will, on the other hand, open up an immense field for electrical development, and no doubt American promoters and engineers are keeping an eye on China's promising future.

THE SPRAGUE ELECTRIC COMPANY, of New York, has recently received quite a number of good-sized foreign orders for its electrical specialties. Twelve Lundell motors and controllers, varying from 1 horse-power to 7½ horse-power, have been ordered for shipment to Vladivostock, where they will be utilized for driving presses in a printing establishment in that Siberian city. The value of the contract is stated to be $12,000. Sar Ries & Company, of Rangoon, have contracted for the supply of a large lot of switchboard material and miscellaneous electrical supplies for the principal Rangoon hotel, which was recently supplied with an electrical plant by the Sprague Company. An order has also been received from Bagnall & Hilles, of Singapore, for a direct-connected unit for lighting a steamer now being overhauled at that port. A large order of fan motors and exhaust fans of various sizes is now being prepared for shipment to Boeck Brothers, of Shanghai, for the warehouse of the National Association of American Manufacturers at that Chinese port.

AMERICAN COAL FOR RUSSIA.—The first shipment of American coal for the Imperial Railways of Russia will be made during the second week in June. Original cost and freight will make the coal cost, delivered at Odessa, $12.24 a ton, which is 96 cents below the cost of English coal. The whole Russian contract is for 40,000 tons to be delivered in ten sailings. The demand for American coal from European countries continues, and inquiries are being received by United States consuls from various European cities regarding the available supply. Messrs. J. Gompel & Company, Rotterdam, Holland, desire to enter into business relations with American coal exporters. The Kobe (Japan) *Daily News*, referring to the recent importation into that country of a cargo of Virginia coal, says it marks a new era in the coal trade of Japan. The coal famine in Germany continues.

INDIGESTION OF PROSPERITY.—Senator Depew recently expressed his views concerning the industrial conditions in this country. He gave it as his opinion that the country is at present suffering not from business stagnation or overproduction, but rather from an indigestion of prosperity. There is a new factor in the situation, he said, a factor that cannot be overlooked, that is, the great demand from abroad for our goods—a demand, the extent and volume of which we have not as yet begun to realize. Coming from so eminent a student of events, this hint should open the eyes of those of our manufacturers who are not seizing the opportunities presented for the expansion of trade and commerce.

ELECTRICAL MACHINERY FOR EXPORT.—It is stated that the orders coming from France for electrical machinery and equipment continue highly satisfactory, but they are said to be diminishing as the Paris Exposition work progresses. There is a very active demand for railroad equipments and material. Weekly shipments of $25,000 in car material have been going forward for the past six or eight weeks, and according to the statements of the steamship agents, they will continue for another month at the same rate. Upward of 300,000 of copper bars constituted part of the cargo of the steamer La Touraine on her last voyage to Havre.

THE ELEVATED'S POWER HOUSE.—The Fuel Economizer Company, Matteawan, N. Y., has been awarded a contract by the Manhattan Railway Company, New York, for fuel economizers of a total capacity of 34,000 horse-power. These economizers are to be installed in Manhattan's new electric power house. This is said to be about the largest order ever given for economizers.

AMERICAN MACHINERY AT THE PARIS EXPOSITION.—A Paris despatch states that a large part of the American machinery at the Paris Exposition has been sold to French buyers since the opening, and there is no doubt that all exhibited will be sold before the close. French firms, it is reported, have already opened negotiations for the greater part.

ELECTRICAL INTERESTS IN INDIA.—E. A. Carolan, assistant manager of the foreign department of the General Electric Company, is now in India in the interest of that company. He will shortly proceed to China, where a number of matters will claim his attention. Mr. Carolan is not expected to return to New York for several months.

AMERICAN AUTOMOBILES IN GERMANY.—An American resident in Berlin, who is in touch with German electrical affairs, writes us as follows: "As the German field has as yet been little worked in automobiles, American manufacturers should be urged to exhibit their automobiles in the principal German cities."

THE WESTINGHOUSE MACHINE COMPANY has secured another order for a 2500-hp engine for the equipment of the Willesden plant of the Metropolitan Electric Supply Company of London. This makes the fifth order received from the English concern for engines of the same type.

BULLOCK APPARATUS FOR MONTREAL.—The Bullock Electric Manufacturing Company has received an order from a Montreal paper for a complete electrical outfit, including dynamos and motors, amounting to several hundred horse-power.

MESSRS. GOULD & EBERHARDT, Newark, N. J., have recently added an electrical equipment to their plant. They are now putting in a number of special machine tools.

Special Correspondence.

ENGLISH NOTES.

London Office of ELECTRICAL WORLD AND ENGINEER,
May 5, 1900.

THE AUTOMOBILE TRIALS.—From all accounts the automobilists who started on the 1000 miles' trial of endurance have been enjoying a very good time, and, with one or two exceptions, no mishaps of any kind have occurred. They have now visited Bristol, Birmingham, Manchester, Preston and Carlisle, and are at present enjoying themselves in the bracing air of Scotland. One of the features of the ride has been the hill-climbing trial from Minto Bridge, Kendal (a beautiful little town situated in the midst of the English lake scenery) to the summit of Shap Fell, a distance of 8¼ miles, with a rise of nearly 1200 ft. The steepest gradient encountered is about 10 per cent, and about 30 out of the 50 vehicles succeeded in reaching the summit, although on the route chosen some still heavier grades will have to be overcome.

THE TELEGRAPH DEPARTMENT of the post office is at present completing the work of laying an underground cable between the head office at St. Martin's-le-Grand, London, and the Birmingham central post office. When completed this wire will be the longest stretch of underground cable in the world, and a keen interest will be taken in the experiment. If it is successful, it will be of immense advantage to the telegraph service. The work was commenced about three years ago, and has been much protracted by unavoidable delays. The cable, which was laid down originally as a reserve line, in case of storms or damage to the existing overhead lines, is composed of 76 conductors, and is insulated with paper. Two companies have been engaged in its manufacture, the British Insulated Wire Company, of Prescott, and the Western Electric Company, of London.

ELECTRIC POWER BILLS.—Reference has frequently been made in this column to the Electric Power bills which have been promoted this year in Parliament. These have now reached a most interesting point, and the most crucial in their career. A committee of seven members of the House of Commons began this week the consideration of these bills by which different companies seek to obtain power to supply electricity over large areas. The county of Durham bill incorporates a company for the supply of electrical energy over a large district south of the Tyne, Sunderland, however, by its own wish, being excluded. The generating station was to be at Gateshead, and the whole of the local authorities concerned, with the exception of two small districts outside that borough, approved of the scheme. The proposed company would not be able to enter any district and distribute electricity in competition with any local authority having the power of supply; but, on the other hand, it would be able most usefully to assist any authority in need of a supply, and by manufacturing on a large scale, and by having, moreover, a continuous demand night and day—first for lighting purposes and then for power—it would be able to sell the energy at an exceedingly cheap rate. The distribution of energy within the area of any local authority taking a supply would be left to the local authority. The local authorities would themselves break up the streets for the purpose of laying the mains, the company paying the cost, and the municipalities taking a supply would also have a voice as to the route to be taken. The learned counsel gave statistics to show that electrical energy could be most cheaply produced on a large scale, and said the company would be able to supply the energy at from a penny to three halfpence per unit and still leave a fair remuneration for its capital. No decision has as yet been given, but it is now generally believed and hoped that it will be favorable.

RELATIONS BETWEEN ELECTRICITY AND ENGINEERING.—At the Institute of Civil Engineers, Westminster, this week, Sir William H. Preece, K.C.B., F.R.S., delivered the annual "James Forrest" lecture, taking for his subject the relations between electricity and engineering. The president of the Institute, Sir Douglas Fox, was in the chair. Sir William Preece at the outset described some of the uses to which electricity was applied, special prominence being given to some recent inventions. The decomposing bath and the arc furnace, he said, were revolutionizing many industries. The regulation of the ever-growing traffic on our railways and the safety of passengers was secured by electricity. The telegraph not only placed the manager of the line in communication with every station upon his system, but electric signals controlled the motion of every train. Speaking of the transmission of power, the lecturer said the economy and efficiency of distributing power over mills, factories and workshops by electricity instead of by shafting, gearing and belts were so pronounced that the change was being effected in every country with great rapidity. Electricity as an economizer, by increasing the speed of output and by reducing waste, was as much at the disposal of the British as of the American manufacturer. But John Bull clung with affectionate and conservative fervor to the capital expended by his grandfather, while Uncle Sam did not hesitate to throw obsolete plant on the scrap heap if by doing so he could increase his business. For traction purposes electricity was making gigantic strides. The Liverpool & Manchester Lightning Express Railway, promoted by a powerful representative syndicate of those two great commercial centres to carry out the scheme of Mr. Behr, was a very bold and promising venture. The line was to be mono-rail 34 miles long, direct between the two cities, without any intermediate station and with no crossing. There were to be cars every 10 minutes. The speed was to be 100 miles per hour, and the time of transit 20 minutes. He knew of no reason why this should not be done in safety and comfort. Speaking of the application of electricity to industries, Sir William Preece described a new jacquard loom invented by Mr. T. A. B. Carver, a pupil of Lord Kelvin. In this loom 600 hooks were controlled electrically. The twill, as well as the pattern, was under complete management. It had been warmly taken up in Glasgow, and a factory had been started there. The pattern on the cloth was woven directly from a photo-print of the artist's design mounted on a metallic sheet. The threads of the warp were picked up by electromagnetic action owing to the figure of the pattern being cut away, thus allowing the circuit to be completed by the metallic sheet. The thanks of the meeting were given to Sir William Preece for his lecture, on the motion of the president, seconded by Sir F. Bramwell.

General News.

THE TELEPHONE.

HARRISBURG, PA.—The Harrisburg Telephone & Telegraph Company has been organized.

SIDNEY, ILL.—The Sidney Telephone Company has been organized by John M. Love, P. H. Muran, W. P. Jones.

PHILADELPHIA, PA.—The Cumberland Valley Telephone Company has voted to increase the capital stock from $50,000 to $75,000.

MARTINSBURG, W. VA.—The Winchester Telephone Company's line between this city and Shepherdstown has been completed.

JAMESTOWN, MINN.—A rural telephone service is to be established between Valley City and Getchell. The line will extend out 12 miles.

CLINTON, WIS.—The Clinton Telephone Company now has more than sufficient stock subscribed to put in a fine large exchange. About 50 telephones are contracted for.

PLAINFIELD, IND.—The Plainfield Telephone Company has been incorporated. Capital, $7,000. Incorporators: A. Curtis, W. B. Welsh, A. Ballard, all of Plainfield.

RAVENNA, OHIO.—The Central Union Telephone Company has commenced the work of reconstructing its exchange at this point. Considerable new cable has been received.

COLUMBUS, OHIO.—The general offices for this district of the Central Union Telephone Company have been removed from this city to the company's headquarters at Chicago.

CHARLOTTE, N. C.—The Raleigh, N. C., Telephone Company has been organized, with a capital stock of $15,000. The company expects to have an exchange of 1000 telephones.

TIPPECANOE CITY, OHIO.—The Tippecanoe Telephone Company has been incorporated. Capital, $10,000. Incorporators: J. A. Kerr, J. C. Geyer, E. J. Kerr, S. Perkins, F. E. Kerr.

WILLIAMSPORT, PA.—At a meeting of the stockholders of the Central Pennsylvania Telephone Company it was decided to increase the capital stock from $1,000,000 to $1,500,000.

FARBER, MO.—A company composed of citizens of this place has been organized to construct and operate a telephone line from Farber to Vandalia, connecting with other lines from Vandalia.

ABILENE, KAN.—The Independent telephone system has extended its lines west to Salina and now has all of this county and Salina with connections to the south into Marion and Mossis in operation.

LA CROSSE, WIS.—The La Crosse Telephone Company has completed an all-metallic circuit with towns to the south as far as Prairie du Chien and it promises to be one of the company's best toll lines.

DOVER, DEL.—The Wyoming Telephone Company has been chartered. Capital, $10,000. Incorporators: A. P. Bedford, of Scranton; O. S. Skinner, of Tunkhannock; N. F. Dickinson, of Lake Covey, Pa.

DUBUQUE, IOWA.—The Dubuque Telephone Company has been chartered. Capital, $100,000. Incorporators: V. H. Stevens, R. W. Stewart, J. H. Ellsworth, O. J. Hager, G. J. Cars, C. A. Beeman, all of Dubuque.

ST. PAUL, MINN.—The Luverne Telephone Company, of Luverne, has been incorporated. Capital, $10,000. Incorporators: E. A. Brown, J. A. Kennicott, A. D. La Due, V. C. Mead, G. W. Millhouse, all of Luverne.

LAWRENCEBURG, IND.—The Lawrenceburg, Guilford & Dover Telephone Company has been chartered. Capital, $10,000. Incorporators: H. W. Nowlin, W. H. Dawson, both of Guilford; H. Fitch, of Lawrenceburg.

WILLMAR, MINN.—The Northern Electric Telephone Company, of Willmar, has been incorporated. Capital, $30,000. Incorporators: D. N. Tallman, J. Williams, A. Larson, all of Willmar; J. L. Schoch, C. H. Dirks, both of New Ulm.

PHILADELPHIA, PA.—The Keystone Telephone Company ordinance has passed both Chambers of Councils by large majorities. Protests against the passage of the ordinance were made by the Municipal League and the Trades' League.

NORFOLK, VA.—The West Norfolk Telephone Company has been incorporated. Capital, $25,000. Incorporators: G. N. Wiel, W. J. Nelms, E. M. Brakton, of Newport News; W. J. Carney, C. W. Coleman, H. Kern, Jr., R. L. Raby, of Norfolk.

LA CROSSE, WIS.—An independent telephone exchange, backed entirely by local capital, has been established in West Salem. The exchange connects with La Crosse and Sparta through the lines of the La Crosse & Southeastern Telephone Company.

WARREN, OHIO.—The Jefferson & Warren Telephone Company, which is connected with the Warren & Niles Telephone Company, is about to establish a branch line via Orangeville, connecting with the Mercer County (Pa.) and the Meadville (Pa.) systems.

NEW YORK, N. Y.—At the annual stockholders' meeting of the Mexican Telephone Company, W. C. Carson, New York; Charles H. Rollins, Boston, and Otis Kimball, Boston, were elected directors, succeeding Robert Colgate, James H. Dawes and Godfrey Morse.

NEW WASHINGTON, IND.—The Ohio Valley Telephone Company is negotiating for the purchase of the New Washington & Nabb telephone line. It is the purpose of the telephone company to establish long-distance service in every town in this part of Indiana.

CHICAGO, ILL.—Mayor Harrison has directed the abandonment of the proposed municipal telephone system. The Chicago Telephone Company has reduced its price from $5 to $1.50 per instrument. This means the city will pay $2,250 a year instead of $7,500.

ITHACA, N. Y.—The Ithaca Telephone Company of Ithaca, has been incorporated with a capital of $10,000. Directors: John P. Van Ostrand, F. S. Bronson, Lansing G. Haskins, Fred C. Bloodgood, Mark T. Atchley, William Thomas and Arthur W. Sperry, of Geneva.

DETROIT, MICH.—The Michigan Telephone Company is about to begin rebuilding its entire system in Bay City. Its wires will be put underground on all streets that are paved or repaved, and the Pittsburg system of high poles in alleys will be adopted in the business section.

MARIETTA, OHIO.—The Marietta Telephone Company, organized some time ago, has commenced work of construction. A number of bids have been made for switchboard and other apparatus, but it is understood that the company has not yet placed contracts for these goods.

ATTLEBORO, MASS.—Selectmen of this town have notified the Providence Telephone Company that it will not be allowed to put wires underground unless free telephones be provided for all departments of the town. Superintendent White, of the company, has refused the request.

LOVELAND, COLO.—A local telephone company has been organized to connect Loveland and Fort Collins and the surrounding country. It will also extend its line to Berthoud and Longmont on the south and to Arkins and Estes Park on the west, and probably reach out to Greeley on the east.

PORTSMOUTH, OHIO.—The Portsmouth Telephone Company's exchange, which has been under way for some time, is nearly completed, and will be placed in operation in the near future. The company has $60,000 invested and is owned entirely by local people. It will start with 600 subscribers.

CHICAGO, ILL.—President Harris, of the board of education, is considering the scheme of inaugurating a private telephone system connecting each school with the office of the superintendent and the business department of the board of education, as well as the police and fire departments of the city.

CAMDEN, N. Y.—The Camden Telegraph & Telephone Company, of Camden, has been incorporated to operate a general telephone system in the cities, towns and villages of Oneida County. Capital, $1,000. Directors: Miner P. Osborne, Maria Osborne, Benton Osborne, Camden; Frank White, Blossvale.

BOSTON, MASS.—The $5,000,000 increase in capital stock of the New England Telephone & Telegraph will be used from time to time for extensions. No action has been taken toward the immediate issue of the new stock. The company spends an average of $1,500,000 yearly in extending its business.

BOSTON, MASS.—Under Erie management the Michigan Telephone Company has in 16 months made a greater gain of subscribers than under the old management covering a period of 20 years. The increase exceeds 100 per cent, or 19,000 subscribers, and the total number connected June 1 will be 38,000.

ALBANY, N. Y.—The Allegany Mutual Telephone Company has been incorporated. Capital, $25,000. Incorporators: E. Hamilton, O. W. Robinson, both of Alfred Station; D. L. Langworthy, C. A. Robinson, C. L. Earley, M. A. Greene, H. A. Greene, H. A. Benedict, J. S. Phillips, of Andover; J. S. Phillips, attorneys, Andover.

LANCASTER, OHIO.—The Lancaster Telephone Company has received word from the North Electric Company, of Cleveland, that the 600-drop switchboard for the local exchange has been practically completed and will be shipped in the near future. The Lancaster Company is owned by the Interstate Telephone Company, of Cleveland.

TRENTON, N. J.—The American Electric Telephone Company has been incorporated here, with an authorized capital of $3,000,000. The company is empowered to manufacture telephones and other electric appliances. The incorporators are Barnett R. Ruggles, Henry M. Haveland, of New York, and James C. Young, Jersey City.

BIRMINGHAM, ALA.—Articles of incorporation have been filed by the People's Home Telephone Company. The incorporators are S. B. Claypool, D. M. Forker, W. H. Hassinger and J. J. Altman. The capital is $200,000. The company has recently obtained a charter from the City Council to construct and maintain a telephone system in Birmingham and it is now taking steps to that end.

MOBILE, ALA.—At a stockholders' meeting of the Home Telephone Company the following were elected directors: A. Shirley Benn, James K. Glennon, Adam Glass, W. H. Fitzpatrick, L. C. Fry, A. H. Spira, P. J. Lyons, O. F. Cawthon and D. R. Burgess. At a meeting of the directors the following officers were elected: A. S. Benn, president; J. K. Glennon, vice-president; Adam Glass, treasurer; W. H. Fitzpatrick, secretary; R. L. Douglass, assistant secretary; W. H. Bryant, manager.

COLUMBUS, OHIO.—The Columbus Citizens' Telephone Company has filed a trust mortgage to the State Savings Bank & Trust Company for $750,000 to secure its bonds. The mortgage runs for 20 years and bears 5 per cent interest. The conditions of the mortgage are such that after 3600 telephones have been placed in operation the company may issue $50,000 more bonds for every 400 additional telephones put in. The company expects to have its system in operation by June 1.

ATLANTIC CITY, N. J.—The Eastern Telegraph & Telephone Company, which was recently incorporated in Trenton, has absorbed the rights and franchises of the South Jersey Telegraph & Telephone Company, which holds a franchise in every county in South Jersey, and steps are being taken to obtain connection with New York. The stockholders of the new company include J. Willard Morgan, John J. Burleigh, Judge Armstrong, ex-Sheriff Baird and other prominent men in Camden.

CHEYENNE, WYO.—President Wallace, of the Rocky Mountain Bell Telephone Company states that his company will expend $200,000 in Wyoming during the coming summer in the construction of new lines. He also states that a telephone line will be built from Cheyenne north this summer, connecting the towns of Guernsey, Lusk, Glenrock, Casper, Douglas and Orin Junction with the Wyoming and Colorado capitals. The company is now looking for a site in Cheyenne on which a $30,000 exchange building will be built.

ELECTRIC LIGHT AND POWER.

SPARTA, TENN.—A move is on foot to put in an electric light plant in this city.

OXFORD, IND.—The electric light plant, owned by the town, was recently destroyed by fire, causing a loss of $5,000.

WARREN, MASS.—The Warren & Brookfield Electric Light Company has been chartered. Capital, $55,000. Incorporators: F. Slater, G. M. Faulkner, T. C. Perkins.

ALBANY, N. Y.—The Hugenot Electric Light, Heat & Power Company has been incorporated, with a capital of $50,000, to operate in New Rochelle and adjoining towns.

DETROIT, MICH.—The Michigan Central Railway will put in a new boiler shop and electric lighting plant for its shops at Jackson Junction, the whole to cost $80,000.

BOSTON, MASS.—The Massachusetts Electric Company has begun the construction at Campello of a one-story iron and stone light and power building, at a cost of $120,000.

ALBANY, N. Y.—The Orange County Gas & Electric Company was incorporated a few days ago, with a capital of $300,000, to furnish gas and electricity and steam in Middletown.

HARTFORD, CONN.—W. W. Cooper was elected president of the Suffield Electric Light Company at the recent annual meeting. The company will put in meters for the entire system.

SALEM, ORE.—The Oregon Light & Power Company, of Baker City, has been incorporated. Capital, $50,000. Incorporators: G. Thornberg, W. J. Patterson, J. Schmitz, W. J. Moorhead.

STAR JUNCTION, PA.—The Washington Coal & Coke Company, of Star Junction, has adopted electric motors for hauling the product out of its mines, and all the mules have been laid off.

ST. JOHN'S, N. B.—The Electric Light & Power Company, of St. John's, N. B., has recently installed a mechanical draft system. The fan will give draft to five boilers, equal to a chimney 200 ft. in height.

REPUBLIC, WASH.—The Republic Water, Light & Power Company has been incorporated. Capital, $100,000. Incorporators: F. C. Whitney, W. R. Ralston, both of Republic; W. C. Morris, attorney, Republic.

PERTH, ONT.—The Town Council recently refused a tender from the electric light company of this place to light the town for the sum of $1,652 per annum. The Town Council is taking steps to buy out the company.

BRAINERD, MINN.—The Northern Pacific Railroad Company is enlarging its shops at Brainerd, Minn. All of the new equipment will be operated by independent electric motors attached to the different machines.

OSWEGO, N. Y.—The People's Gas & Electric Company, of Oswego, has been incorporated. Capital, $450,000. Incorporators: H. P. Kernochan, Jr., J. J. Kennedy, both of Albany; H. Footman, E. N. P. Douley, S. Stein, all of Schenectady.

KENOSHA, WIS.—It is reported that Milwaukee men, including A. E. Smith and E. J. Cowdery, of the gas company, are negotiating for the purchase of all the electric and gas lighting plants. The Milwaukee men represent Eastern capitalists.

CAMDEN, N. J.—The West Jersey Electric Company has been chartered. Capital, $40,000. Incorporators: R. L. Anderson, of Haddonfield; D. L. Clever, W. S. Moslander, both of Camden; R. A. Sheets, of Westmont; J. F. Harned, of Camden.

BALTIMORE, MD.—The Delaware & Susquehanna Electric Light & Railway Company, of Cecil County, organized in Elkton by electing Joseph T. Grove, president; Carlton Kimble, vice-president, and Alfred B. McVey, secretary and treasurer. The capital stock of the company is $100,000.

SAN FRANCISCO, CAL.—The Pacific Power Company, which maintains an electric generating station at 23 Stevenson Street, San Francisco, and supplies power to a large number of factories, etc., from its mains, recently suffered a small loss from the explosion of a boiler. The fireman, James Shea, was fatally scalded. The cause of explosion is unknown.

OTTAWA, ONT.—Some months ago a special committee of the City Council of Ottawa was appointed to inquire into and report on the advisability of obtaining a municipal lighting plant. No action was taken until recently. Since the Hull-Ottawa fire the committee has requested the Ottawa Electric Company to name its lowest price for its plant, power, power house and good will.

PURCELL, I. T.—A company has been formed here, with $12,000 capital stock to rebuild the electric light plant. Duplicate machinery will be installed and 1000 new lights wired. R. B. Stichter, of Louisiana, Mo., and E. S. Aldrich, of Waynetown, Ind., will have charge of the reconstruction and operation of the plant. Work will begin at once. The alternating current will be used.

PITTSBURG, PA.—The electric power department of the Monongahela Electric Light & Power Company was put into operation last week, with a capacity of three 500-kw Westinghouse generators, furnishing power to the Monongahela Traction Company, and the McKeesport & Duquesne Traction Company. The electric lighting department of the company will go into operation by July.

SAN FRANCISCO, CAL.—The Comstock Pumping Association, of which Charles Hirschfeld is president, will have a called meeting on May 7, for the purpose of opening bids for a pumping plant to operate with electric power in the C & C shaft, near Virginia City, Nev. The present hydraulic pumping operations are progressing favorably, and the electric power transmission plant will probably be ready July 1.

LIMA, OHIO—The Faurot property, including the electric light plant in this city and a leading business block, were sold at master commissioner's sale a few days ago and were struck off as a whole to the Cleveland Trust Company, Cleveland, as trustee for the holders of the first mortgage bonds. The amount paid

was $272,200. The electric lighting plant was appraised at $150,000 and the best bid for this piece of property alone was $105,000, made by Jacob Mayer, of New York City.

DENVER, COLO.—The Telluride Power & Transmission Company has arranged for the erection of a big plant at Tintic, Utah, which will furnish power for the mines of that district and also electric lights for the city. A separate company will be organized to supply the city with light and contracts have been made with the Sioux-Ajax Tunnel Company and the Lower Mammoth mine, for the supplying of the necessary power, so that the plant will be in operation early in the summer.

CAMDEN, N. J.—The American Investment Company has purchased the Gloucester City electric light plant. The American Investment Co. is the same corporation that has purchased the electric light and gas plants in a number of other places, including Woodbury, Merchantville, Moorestown and Mt. Holly. In time it is the intention to conduct the several plants as one company. The American Investment Company is also negotiating for the Camden, Gloucester & Woodbury trolley road.

THE ELECTRIC RAILWAY.

CHAGRIN FALLS, OHIO.—Work on the Troy extension of the Chagrin Falls & Eastern Electric Railway has been resumed.

ELYRIA, OHIO.—Work has been started in Oberlin on the Wellington branch of the Cleveland, Elyria & Western Electric Railway.

GLENVILLE, OHIO.—This town proposes to issue bonds to the amount of $50,000 for the purpose of building a municipal electric lighting plant.

CONNEAUT, OHIO.—The Pennsylvania & Ohio Electric Railway Company is making plans to extend its line from this place to Ashtabula and Erie, Pa.

LIMA, OHIO.—The route of the Lima, Wapakoneta & St. Mary's electric line through Cridersville will be abandoned and the road will be built through Hume.

DOVER, DEL.—The rails, tools and implements of the old Delaware Electric Railway Company have been seized by the sheriff for a debt, and will be sold at public sale.

CAMDEN, N. J.—The United States Electric Railway & Light Company has been incorporated. Capital, $125,000. Incorporators: F. R. Hamsell, G. H. B. Martin, W. F. Eidell.

SPRINGFIELD, OHIO.—The National Traction Company has applied for a franchise to build an electric line through Clark County, along the National road from Columbus to Indianapolis.

DETROIT, MICH.—The management of the Consolidated Street Railways of Detroit have formally refused to accede to a request of the employees for an increase in wages of 2 cents per hour.

COLUMBUS, OHIO.—The directors of the Columbus and Lancaster Electric Railroad Company have voted to increase the capital stock of the company. The present limit is $500,000, and it will be raised to $1,000,000.

AKRON, OHIO.—The Akron & Cuyahoga Falls Rapid Transit Company is making preparations to extend its line from Kent to Ravenna. An extension is now being built from Barbarton to Johnsons, two miles south.

CLEVELAND, OHIO.—Because of the building of extensions to North Amherst and Wellington, the Cleveland, Berea, Elyria & Oberlin Electric Railway Company has changed its name to the Cleveland, Elyria & Western.

ESCANABA, MICH.—Escanaba's electric railway is to be extended northward to Gladstone and Rapid River, a distance of 21 miles. Work on the extension will be begun soon and the line completed at least to Gladstone this season.

YOUNGSTOWN, OHIO.—The projectors of the road from this place to New Castle, Pa., have been unable to secure the right of way between the two towns, and it is probable that the project will be abandoned for the present at least.

WILMINGTON, DEL.—The Citizens' Traction Company, of Wilmington, a new corporation, has made application for permission to lay tracks on many of the principal streets of the city. Tilghman Johnston represents the company.

LONDON, OHIO.—The Columbus, London & Springfield Electric Railway Company has made application for a franchise to the county commissioners of Madison County. The company has agreed to locate its power house at London.

RICHMOND, VA.—President E. L. Bemiss and Superintendent S. R. Cowardin, of the Traction Company, have made an increase of 10 per cent in the wages of the employees who have served one year and a provisional increase for all on the line.

NEW ALBANY, IND.—The receipts of the New Albany Electric Street Railway Company for the month of March, according to the report of Receiver Louis Hartman were as follows: Income, $3,228.61; expenses, $2,362.10; net earnings, $876.51.

COLUMBUS, OHIO.—A new company, to be known as the Central Market Street Railway Company, is being organized by prominent citizens, among them S. B. Hartman, W. V. Baker and Frank Hartman, to secure a foothold for electric lines in this city.

CHILLICOTHE, OHIO.—The Chillicothe, Mt. Sterling & Columbus Electric Railway Company has been incorporated. Capital, $110,000. Incorporators: J. C. Eutrikin, I. S. Cook, S. F. Secrest, J. Honk, J. P. Myers, O. M. Houser, L. F. Thomas, W. C. Bostwick.

SELLERSVILLE, PA.—The Inland Traction Company has opened its trolley line from Lansdale to Sellersville, a distance of 13 miles. Hugh E. Crilly, of Allentown, is the owner and managing director of the road. The line will be extended from Lansdale to Chestnut Hill.

NORFOLK, VA.—The consolidation of the Citizens' Railway, Light & Power Company, the Peninsular Railway, the Chesapeake & Hampton Roads and the Peninsular Light & Power, at Newport News, has been completed. W. A. Post has been elected president of the consolidation.

BINGHAMTON, N. Y.—An effort is being made to consolidate the Erie & Central New York Railroad and the Cortland & Homer Traction Company, which will connect the two villages. The scheme is to fund the bonds of the two companies, aggregating $600,000, by an issue of $500,000 at 5 per cent.

GREENSBURG, PA.—The Greensburg, Jeannette & Pittsburg Street Railway has been sold at trustee's sale to J. B. Head for the Harrisburg Traction Company for $25,000. The new company will at once make extensive improvements, and in a short time extend the line to Pittsburg, a distance of 26 miles.

BOSTON, MASS.—The railroad commissioners have approved the grant of the location of the tracks of the West End Street Railway Company on Boylston Street, in Brookline, from Cypress Street to the Newton line. The location was originally granted by the unanimous action of the selectmen of Brookline.

NEWARK, OHIO.—The Licking County Commissioners have granted a franchise to the Lancaster & Newark Traction Company. The road will extend from Lancaster to Hebron, where it will connect with the Columbus, Buckeye Lake & Newark road running into Newark. A similar franchise has been granted in Fairfield County.

COLUMBUS, OHIO.—The Columbus Railway Company has closed all necessary contracts with property owners for running an electric line through the suburban section known as Arlington and Grand View Heights. The line will be conducted as a separate organization and has been incorporated as the Columbus Suburban Railway Company, with a capital stock of $150,000.

TOLEDO, OHIO.—A gigantic electric railway scheme is announced here. It contemplates a network of lines, centering in Toledo on one side, Sandusky and Cleveland on the other, and embracing Tiffin, Fremont, Ottawa, Findlay, Port Clinton and several other Ohio points. It is capitalized at $3,000,000, and among the leading promoters are R. W. Brown, W. M. Starr and Ricard Young, of Tiffin. An Eastern trust company is said to be furnishnig some of the funds.

NEW PHILADELPHIA, OHIO.—Stockholders of the Tuscarawas Electric Railway Company have elected the following officers: F. T. Pomeroy, Cleveland, president; J. A. Rutherford, Cleveland, vice-president; William Akins, New Philadelphia, secretary, treasurer and general manager; directors, F. T. Pomeroy, J. A. Rutherford, J. O. Wilson, Cleveland; Will Christy, Akron, and George Bowers, New Philadelphia. New cars will be purchased and a number of other improvements made to the road.

GLOVERSVILLE, N. Y.—The directors of the Cayadutta Electric Railroad have authorized a mortgage for $600,000 on the entire property of the road, to the New York Security & Trust Company, of New York, as trustee, to secure an issue of consolidated 5 per cent bonds of the amount of the mortgage. Of this amount $350,000 are to be held by the trustees to retire the first mortgage 6 per cent bonds maturing in 1922, and the balance, $250,000 is to be used to pay the present floating debt and for future improvements.

CLEVELAND, OHIO.—The Cleveland Electric Railway Company has broken ground for an extensive addition to its central power house on Cedar Avenue. Contracts have been placed with the General Electric Company for two units, one of 2000 kilowatts and the other 1600 kilowatts. The engine for the larger generator is to be furnished by the E. P. Allis Company, of Milwaukee, and that for the smaller by C. & G. Cooper Company, of Mt. Vernon, Ohio. The new additions will give an increase of between 5000 and 6000 horse-power.

NEW YORK, N. Y.—The new time table for the Third Avenue Railroad introduced by the Metropolitan management makes what is tantamount to a reduction of 10 per cent in wages. The old rate of wages was $2.50 a day for motormen and $2.25 for conductors, there being no gradation of pay on account of length of service. Under the new schedule the pay will be graded according to service. New appointees will receive $2 a day, and after a year's service $2.15, and after two years $2.25. Motormen and conductors will receive the same pay.

CLEVELAND, OHIO.—The completion of the organization of the Southern Ohio Traction Company has been effected at Hamilton. The following directors were elected: Will Christy, Akron; M. J. Mandelbaum, Cleveland; H. Clark Ford, Cleveland; James Christy, Jr., Akron; H. R. Newcomb, Lakewood; D. H. Kimberley, H. A. Sherwin, R. A. Harman, Cleveland; R. M. Parmalee, East Cleveland, and Peter Schwab, Hamilton. The directors met in this city afterward and elected Will Christy, president; F. J. Sloat, manager, and Warren Bicknell, auditor.

COLUMBUS, OHIO.—There have been a number of developments recently in the efforts being made by interurban roads to secure entrance into the centre of this city. The first road to secure the desired privilege will probably be the Worthington, Clintonville & Columbus Railway Company, which has completed arrangements with the Columbus Railway Company. The City Council granted a franchise to the Columbus, London & Springfield Electric Railway Company granting it a right of way into the city and the use of a loop around Rich, Third, Gay, Water and Scioto streets, which will probably be used by all the interurban companies. The Columbus, New Albany & Johnstown Electric Railway Company has withdrawn its application for permission to operate over the tracks of the Columbus Railway Company and will introduce an ordinance similar to that given to the Springfield company for a franchise into the city.

THE AUTOMOBILE.

THE LINCOLN ELECTRIC COMPANY, Cleveland, Ohio, reports that the demand for its special vehicle motor is developing beyond expectations. Last week the company made a shipment of 24 2½-hp horseless carriage motors to the Kensington Bicycle Manufacturing Company, of Buffalo, which is engaging extensively in the manufacture of electric vehicles.

AUTOMOBILE REPAIR WAGONS.—A series of tests were conducted last week in Brooklyn of an electric emergency or repair wagon. They were witnessed by officials of the Brooklyn Rapid Transit Company, and, it is said, were satisfactory. It is stated that these automobiles will soon replace the horse-propelled emergency wagons now used by the Brooklyn Rapid Transit Company.

THE UNITED POWER VEHICLE COMPANY, of New York, has been incorporated to manufacture and deal in electrical, gasolene and steam vehicles. Capital, $1,000,000. Incorporators: J. McNab, J. Hood, G. Hollinshed, H. H. Willis, C. Blakie, all of Brooklyn, N. Y.; J. Cummins, attorney, New York City.

THE PAINESVILLE AUTOMOBILE COMPANY, Painesville, Ohio, has been incorporated, with a capital stock of $10,000, by George W. Blackmore, J. P. Borden, E. D. Hartwell and others. The company proposes to operate an automobile bus line between Painesville and Fairport. A contract for several vehicles has been placed with the Hasbrook Motor Company, and the first of these will shortly be placed in operation.

NEW INDUSTRIAL COMPANIES.

THE GENEVA ELECTRIC EQUIPMENT & CONSTRUCTION COMPANY has been organized in New York City, with a capital stock of $10,000. The directors are Edgar Swain and Adolf Hirschfeld, New York.

THE VARNEY ELECTRICAL SUPPLY COMPANY has been incorporated at Indianapolis, Ind., to manufacture electrical machinery. Capital, $300,000. Incorporators: G. E. Varney, A. V. Brown, C. O. Britton, all of Indianapolis.

THE EDISON MANUFACTURING COMPANY has been incorporated in Newark, N. J., with a capital stock of $500,000. The incorporators are: Howard W. Hays, E. H. Duryea and John E. Helm. The object of the company is to sell all kinds of machinery and mechanical and electrical appliances.

THE CONSTANT BATTERY COMPANY, New York City, has been incorporated at Albany. Capital, $100,000. Incorporators: E. Tweedy, B. Levyn, M. Rofalsky, all of New York City; Phillips & Avery, attorneys, New York City.

THE D'OLIER ENGINEERING COMPANY, of Camden, N. J., has been chartered to deal in electrical machinery. Capital, $50,000. Incorporators: W. L. D'Olier, H. D'Olier, both of Philadelphia; F. W. D'Olier, of Burlington; D. J. Pancoast, attorney, Camden.

THE AMERICAN INCANDESCENT LIGHT COMPANY, of Portland, Maine, has been incorporated to manufacture and deal in electrical appliances. Capital, $10,000. Incorporators: F. E. Dickerman, H. G. Allbright, C. Perillot, J. S. Newcomb, all of Boston, Mass.; P. J. Larrabee, attorney, Portland.

THE H. P. CAMERON ELECTRICAL MANUFACTURING COMPANY has been incorporated in Syracuse, N. Y., to manufacture electrical appliances. The capital stock is $10,000, and the incorporators are M. L. Oberdorfer, H. P. Cameron, F. T. Pierson, all of Syracuse; Knapp, Nottingham & Andrews, attorneys, Syracuse.

THE TAYLOR SIGNAL COMPANY, of Buffalo, has been incorporated at Albany, with a capital of $500,000, to manufacture and sell railroad signaling devices, switches, machinery, tools and appliances. The directors are: Charles W. Goodyear, Alvah W. Hall, Amos W. Morgan, Andrew Langdon, George D. Morgan, William L. Marcy, Horatio C. Harrower, John J. McWilliams, of Buffalo; William G. Hovey, of Chicago.

THE WILLIAMS TRACK JOINT COMPANY has been formed in Kansas City, Mo., to manufacture and deal in railroad and electric railway supplies and appliances. The capital stock of the company is $100,000. The incorporators are: George H. Williams, St. Louis, Mo.; S. W. Leslie, Kansas City; Hal Corder and James I. Geddes, Joplin, Mo., and J. W. Baker and George T. Baker, Joplin, Mo.

LEGAL.

TROLLEY TO PAY BRIDGE TOLLS.—Judge Mestrezat, of the Supreme Court of the State of Pennsylvania, has rendered a decision in the case of the Birmingham Traction Company against the city of Pittsburg, in which he decides that trolley companies must pay toll to the municipality, where the street car company traverses bridges owned by the city, as a corporation. In this case, the Birmingham Traction Company has to pay to the city of Pittsburg $75,000.

LEAD-COVERED CABLES.—A complaint has been entered in the United States Circuit Court in which the Electric Cable Construction & Maintenance Company, of Philadelphia, charges the National Conduit & Cable Company, of New York, with an infringement on a patented improvement in lead-covered electrical conductors, the patent being owned by the complainant company. The complainant asks for an accounting and payment of the moneys accruing from the alleged infringement, and for a perpetual injunction against the defendant.

OBITUARY.

MR. TIMOTHY M. BOSART, vice-president and business manager of the Jenney Electric Manufacturing Company, died suddenly of heart disease May 6 at Washington Street and the Belt Railroad, Indianapolis, while waiting for a street car. He had been at the factory all morning and was on his way home for luncheon. While standing beside the track with Mr. Harvey Coonse he sank unconscious to the ground. It was seen that he was seriously ill and he was carried into a near-by office and placed on a couch, where he died about five minutes later. Dr. M. J. Spencer was called, but did not reach him before he died. Mr. Bosart was born in Springfield, Ohio, April 12, 1844. He came to Indianapolis in 1866, and was engaged in the retail grocery business, and afterward, for 20 years, he was with George W. Stout, the wholesale grocer. He then became identified with the Yaryan Fifth-wheel Company, and in 1898 was made vice-president and general manager of the Jenney Electric Company. He was a successful financier, and by his own efforts accumulated considerable property. He was married in Illinois in 1876, and lived for 18 years in the home east of Irvington. He was an active member of the Central Christian Church, and was a member of the board of deacons and also of the board of elders. He leaves a widow and five children—Oscar, 20 years of age, now a student at Purdue University; Bertha, Ruth, Dora and a small son. The funeral arrangements have not yet been made.

PERSONAL.

MR. A. B. CHANDLER, president of the Postal Telegraph Company, who is visiting the Pacific Coast, spent several days in San Francisco recently.

MR. KOHEI OIWA, the electrical engineer of the Japanese Government's Ministry of Communication, recently arrived in San Francisco on a visit to this country.

MR. E. R. KNOWLES, consulting engineer, New York, has been retained by Seward, Guthrie & Stube, New York City, as consulting expert in the case of Dechert vs. the Municipal Electric Light Company, of Brooklyn.

MR. CHARLES McLAUGHLIN, of J. H. Bunnell & Co., New York, has just returned from a six weeks' pleasure trip through Mexico. He visited all the principal cities and places of interest and returns much improved and invigorated, notwithstanding the fact of his being mixed up in a railroad accident or two, besides being a passenger on a steamer that broke her shaft in the Gulf Stream and lay helpless for 36 hours.

LIEUT. J. B. CAHOON has opened an office in Syracuse, N. Y., as consulting engineer in the branches of electrical, gas and water works engineering. As manager and engineer for some years of the company operating the central station electric railways, gas and water works of Elmira, Lieutenant Cahoon accumulated a valuable store of experience, and especially with reference to the modernization of plants, the Elmira property having been bought by him thoroughly up to date and placed upon a profitable basis. To his qualities as an engineer, Lieutenant Cahoon unites in a high degree those of works manager and expert on central station finance and accounting.

Trade Notes.

THE NUNGESSER ELECTRIC BATTERY COMPANY, Cleveland, Ohio, has increased its capital stock from $10,000 to $25,000.

GLASS INSULATORS.—The Western Electrical Company, St. Louis, Mo., has issued a revised price list of glass line and floor insulators.

OIL HOLE COVERS.—F. D. Winkley, Madison, Wis., is sending out a circular illustrating the various forms of dust-proof, oil-hole covers of his manufacture.

GOULDS' PUMPS.—The Goulds Manufacturing Company, Seneca Falls, N. Y., has issued some advance pages from its 1900 catalogue, giving a partial list of new pumps, etc., with revised lists. Various types of pumps are illustrated.

THE ELECTRIC APPLIANCE COMPANY, Chicago, is inclined to be rather enthusiastic in talking about the line of Dayton fans it has for the season of 1900. It claims that these fans are theoretically, practically, scientifically, electrically and mechanically perfect.

JUNCTION BOXES.—The junction-box department of the Chase-Shawmut Company, Boston, Mass., has just issued a bulletin on Chase "knock-out" junction and outlet boxes. Diagrams of the various forms of these boxes are given, together with dimensions and prices.

GEORGE H. BLAXTER, formerly general manager of the Allegheny County Light Company, Pittsburg, Pa., and R. D. McGonnigle, treasurer of the same company, have organized the United States Tube & Iron Company. They will at once embark in the business of manufacturing pipe and tubing.

THE WESTERN ELECTRICAL SUPPLY COMPANY, of St. Louis, is introducing a neat, and, at the same time, a useful little device in the way of an automatic rotary hand fan. There is no mechanism to get out of order, a ratchet wheel being the only mechanical part. It is worked by the pressure of the hand on the two handles.

MR. R. L. WARNER delivered at the April meeting of the Providence Association of Mechanical Engineers an interesting address on the Niagara Falls power plant. Mr. Warner, as an electrical engineer connected with the Westinghouse Electric & Manufacturing Company, was enabled to treat the question in a thorough manner.

THE NATIONAL CARBON COMPANY, of Cleveland, was represented at the recent Telephone Convention in that city by Mr. E. J. Cline, who was in charge of an interesting exhibit of the company's line of batteries and other specialties for telephone work. He distributed miniature samples of the Columbia Dry Cell for open circuit work.

A LARGE BRIDGE.—The Phœnix Bridge Company, of Pittsburg, Pa., has been awarded the contract by the Quebec Bridge Company, for the erection of a great cantilever bridge over the St. Lawrence River at Quebec. This bridge will be the largest of its kind in the world. The contract involves 27,000 tons of steel and the cost will be $4,000,000.

THE AMERICAN TOLL TELEPHONE COMPANY, Cleveland, Ohio, received from Mr. Maxime Reber during the recent Cleveland Telephone Convention, an order for 500 toll telephone attachments to be used in toll stations of the United States Telephone Company. The company has recently commenced business, and this is the first contract taken.

BELT DRESSING.—The cover of a pamphlet issued by the Stephenson Manufacturing Company, Albany, N. Y., bears the legend "Nude Facts Photographed from Life," and upon investigation within it is found that the reference is to a number of letters reproduced by the photographic process for printing, and speaking in high terms of Stephenson's "Bar Belt Dressing."

ROYAL ALTERNATORS AND TRANSFORMERS.—A new catalogue of the Royal Electric Company, Peoria, Ill., contains a large number of excellent half-tone illustrations showing every detail of Royal alternators and transformers. Much information is included that will interest the reader in search of technical information on the two important kinds of electrical apparatus treated.

THE EDDY ELECTRIC MANUFACTURING COMPANY is making a special feature of automobile motors, the business for which is increasing very rap-

idly with it. A recent visit to its establishment at Windsor, Conn., showed it to be in a busy and prosperous condition there. The facilities are such that prompt deliveries can be made, which, of course, is an important consideration for purchasers.

MONTAUK MULTIPHASE CABLE.—A practical illustration of the capabilities of this fire-detecting wire was given at a recent fire on premises in Melbourne, Australia, where the Montauk cable is installed and connected with the Metropolitan fire station. The first intimation of the outbreak was given through the fire alarm instrument in the building, this being actuated automatically by the fusing of the Montauk cable on the top floor.

THE HOLMES FIBRE GRAPHITE COMPANY, of Philadelphia, has issued a very pretty catalogue on the subject of Air Dash Pots for arc lamps. It is claimed that perfection in this respect is obtained only through the use of fibre-graphite plungers, because this material has several characteristics which cause it to be particularly adapted to this work, among them being the fact that it is self-lubricating, is insensible to heat and cold and is not affected by moisture.

THE GREGORY ELECTRIC COMPANY has recently completed numerous improvements and alterations in its enlarged works in Chicago. These changes were made necessary by its increasing business and this company is now prepared to do business on still smaller margins than heretofore, having reduced the cost of handling to a minimum. All visitors to the coming National Electric Light Convention are cordially invited to inspect its works and warehouses while in Chicago.

THE YORK MANUFACTURING COMPANY, York, Pa., has recently received 10 contracts for refrigerating and ice plants, varying in capacity from 10 to 150 tons. The distribution of the plants is a wide one. They are to be installed in Haverstraw, N. Y.; Montgomery, Ala.; Waynesburg, Pa.; Port Jervis, N. Y.; Worcester, Mass.; Missoula, Mont.; Hamlet, N. C.; Philadelphia, Pa.: Raleigh, N. C., and Washington, D. C. The Philadelphia contract is for a 200-ton ammonia condensing equipment.

THE NORTH ELECTRIC COMPANY, Cleveland, reports that its farmers' community system telephones, which it brought out last fall, is proving one of the most successful specialties in this line ever introduced. A large number of urban exchanges throughout the country have installed this system to furnish service to farmers' communities and its popularity is constantly growing. Several shipments have recently been made abroad and the company looks for an extensive business in this telephone in foreign fields.

E. P. ROBERTS & CO., Cleveland, Ohio, have moved their office to the Electric Building in that city. The firm has recently added to its force Mr. J. F. Pfetch, who has had many years' experience as superintendent and manager of electric railways. A leaflet, just issued by the firm, gives illustrations of the various electric railways and electric light plants installed by it. The text points out the advantages of employing technical advice in the planning and development of undertakings of the character referred to.

THE ERICSSON TELEPHONE COMPANY, 296 Broadway, New York, has just issued part 3 of its little interesting publications, entitled "The Ericsson Series." It contains illustrations of the adjustable arm transmitter and connections of combination wall and desk sets and wall sets. The text gives a popular description of the construction of induction coils and the principle of their operation. It also contains some interesting matter regarding telephony in Norway and Austria, giving the rates, etc., in those countries.

INDUSTRIAL RAILWAYS.—In a pamphlet recently issued, a number of views are given by an industrial railway installed in the great works of the Ludwig Loewe Company, of Berlin, Germany, by the C. W. Hunt Company, of New York. In referring to these works some months ago, the London *Engineering* expresses its regret that after a visit by some of its officers to England and the United States for the purpose of ordering tools, only one small tool was purchased in Great Britain, while hundreds of thousands of dollars were spent in America.

THE BOOKER CARBON & BATTERY COMPANY was incorporated April 24 under the laws of the State of Missouri, with a full paid capital of $50,000. The premises, 2134 DeKalb Street, St. Louis, formerly occupied by the Phœnix Battery & Manufacturing Company, have been leased, and new machinery and appliances are rapidly being installed there. S. G. Booker, one of the incorporators of the company, is one of the best-known men in the business. He states that they will be very shortly in a position to make deliveries of everything in the battery and carbon lines.

FIELD & EVERETT, engineers and electrical experts, heretofore located at 41-43 Cedar Street, New York, have removed their offices to commodious quarters at 11-13 William Street. This firm, composed of Messrs. Frederick C. Field and Frank W. Everett, was organized a little over a year ago for electrical engineering consultation, and has been very successful in that time in establishing a well-deserved reputation for thoroughness and accuracy in many important matters in which they have been retained. A branch office has been established in Havana, Cuba, at 4 Mercaderes, in charge of Mr. Everett.

ELECTRIC MOTORS MAKE EASY WORK OF MOVING.—In the spring of 1899 Hollister Bros., printers, Chicago, Ill., installed 19 Western Electric Company motors to operate their printing plant. It was necessary for them to change their location before May 1, and they found that with the use of motors it was easy for them to move one press at a time, have the same set up and in operation before another one was moved. By this means they were able to move their entire establishment without a single interruption to business, not more than one press being inoperative at a time. In a recent booklet issued by them they give a number of advantages in presses operated by electric motors, and now state that in moving they have found one other advantage.

SHAD DINNER.—The electrical supply dealers of Philadelphia on May 8 gave a shad dinner at Washington Park, N. J., and a very enjoyable time was had. Mr. E. Ward Wilkins, of Partrick, Carter & Wilkins, made a very efficient toast-master. After-dinner remarks were made by Messrs. T. Beran, C. B. Price, W. H. Tapley, William McDevitt, H. C. De Camp, J. J. Gorman, C. M. Wilkins, H. B. Kirkland, H. G. Issertel, H. B. Cutter and H. D. Stanley. Mr. George H. Lukens entertained the party with some humorous remarks, all of which were thoroughly enjoyed. A game of baseball was played, the visitors vanquishing the hosts. A photograph of the party was taken and every one in attendance will receive a copy of the same as a memento of the pleasant occasion.

THE ELECTRICAL APPLIANCE COMPANY, 39 Cortlandt Street, New York, has taken entire charge of placing its gravity-motor controller on the market. A saving of from 35 per cent to 75 per cent is claimed for this automatic controller over ordinary hand rheostats, and special attention is directed to its extreme simplicity and durability. G. A. Nisbet, the manager of the company, states that since the Electrical Appliance Company took control in February, the sales have increased 50 per cent. Among the large manufacturers of motors now installing this device with their products may be mentioned the C & C Electric Company, Crocker-Wheeler Company, Western Electric Company, Martin J. Insull Company, S. B. Condit, Jr., & Co., Chase-Shawmut Company, J. C. Stearns, etc.

THE LINK-BELT MACHINERY COMPANY, Chicago, owing to a great increase of trade in the regular lines of manufacture in which it has been engaged for the past 20 years, and the greatly increased demand for its electric mining and haulage machinery—together exceeding the entire capacity of its plant—has deemed it advisable to retire from the manufacture of electrical machinery and has sold to the Goodman Manufacturing Company the patents, patterns, stock and good will of that part of its business known as the "Electrical Mining Machinery Department." All the unfilled contracts and orders for supplies have been transferred to the Goodman company, which, with ample capital and facilities, will complete the same. The new company, with Mr. H. E. Goodman as general manager, and Mr. Charles E. Davis as superintendent, will continue the manufacture of the electrical mining machinery and specialties so long made by the Link-Belt company.

THE MICA INSULATOR COMPANY, the originators and patentees of "Micanite" and "Empire" insulating materials, have experienced a heavy increase in its business. Some of the finest electrical machinery ever manufactured is insulated with "Micanite." The Mica Insulator Company's factories are located in Schenectady, N. Y., and Stansted, Essex, England. Mr. Charles W. Jefferson, formerly associated with the General Electric Company, is the company's manager at the Schenectady works. Mr. Fred W. Dwyer, also formerly associated with the General Electric Company, is the manager of the English factory. These two gentlemen possess great ability along this line, and those interested in the designing of new apparatus or in securing a remedy for difficult problems connected with the successful insulation of old machinery will do well to correspond direct with these gentlemen. The company's offices are located in London, England, 12 Camomile Street; New York City, 218 Water Street; Chicago, 117-119 Lake Street. It also has branch offices, with stocks, in the following cities: Cincinnati, under the management of the Monroe Brass & Wire Company; St. Louis, under the management of Arthur S. Partridge; Cleveland, represented by the George Worthington Company; San Francisco, under the management of the Brooks-Follis Electric Company, which enables the company to quickly and easily distribute their materials in the respective territories.

REMOVALS.

THE FOLLOWING is a list of recent business removals in New York City and elsewhere:

E. P. ALLIS COMPANY, New York office, to 95 Liberty Street.

WHEELER REFLECTOR COMPANY, Boston, to 100 Purchase Street.

FIELD & EVERETT, from 41 Cedar Street to 11 William Street, New York.

E. V. BAILLARD, from 106 Liberty Street to Fox Building, Franklin Square, New York.

STIRLING COMPANY, New York office, from 95 Liberty Street to 26 Cortlandt Street.

E. P. ROBERTS & CO., from Osborn Building to the Electric Building, Cleveland, Ohio.

THE SCHMIDT & BRUCKNER ELECTRIC COMPANY, to 325 Broadway, New York.

BERLIN IRON BRIDGE COMPANY, New York office, to the St. Paul Building, 220 Broadway.

THE MARTIN J. INSULL COMPANY, from Monadnock Block to 48 West Jackson Boulevard, Chicago.

STANDARD UNDERGROUND CABLE COMPANY, from Times Building to 56 Liberty Street, New York.

FLOY & CARPENTER, from sixteenth floor to twenty-fifth floor, St. Paul Building, 220 Broadway, New York.

THE SIEMENS & HALSKE ELECTRIC COMPANY, from Havemeyer Building to 40 New Street, New York.

CROCKER-WHEELER ELECTRIC COMPANY, New York, general offices from 39 Cortlandt Street to Ampere, N. J.

JEWELL ELECTRICAL INSTRUMENT COMPANY, from 439 Marquette Building to 203 Pontiac Building, Chicago.

ALBERT & J. M. ANDERSON MANUFACTURING COMPANY, New York office, from 123 Liberty Street to 135 Broadway.

THE MONTAUK MULTIPHASE CABLE COMPANY, from eighteenth to nineteenth floor, 100 Broadway, New York.

EASTERN ELECTRICAL CONSTRUCTION COMPANY, Philadelphia, from 658 Bourse Building to 112 North Broad Street.

PITTSBURG REDUCTION COMPANY, New York office, from Havemeyer Building to Phelps-Dodge Building, Cliff and John streets.

Record of Electrical Patents.

UNITED STATES PATENTS, ISSUED MAY 8, 1900.

[Conducted by William A. Rosenbaum, Patent Attorney, 177 Times Bldg., N. Y.]

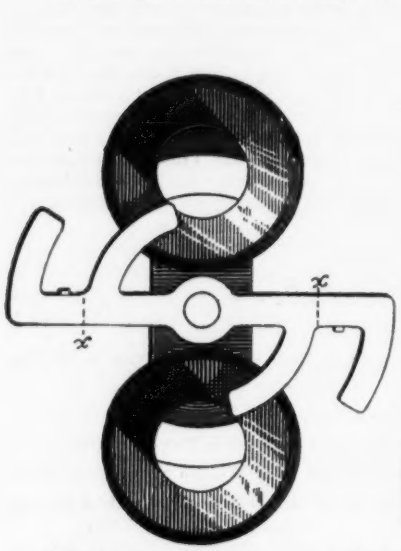
648,919. ELECTRIC TELEGRAPH APPARATUS FOR USE ON CABLE OR OTHER LINES; S. G. Brown, Bournemouth, England. App. filed June 6, 1899. This is a means whereby a relay is capable of being worked by small electrical forces such as are received on long submarine cables. A coil connected in the circuit is mounted to rotate slightly in the field of a permanent magnet. To the coil is attached a needle which is caused to make contact with different insulated rings, each of which is in the circuit of a particular receiving apparatus. A condenser short-circuits the contact between the needle and the rings.

648,939. ELECTRIC CIRCUIT CLOSER; H. H. Fowler and W. F. Pack, Waverley, Tenn. App. filed Dec. 29, 1899. This is a thermostatic device, the invention consisting of a curved expansion member provided with means for adjusting its contour.

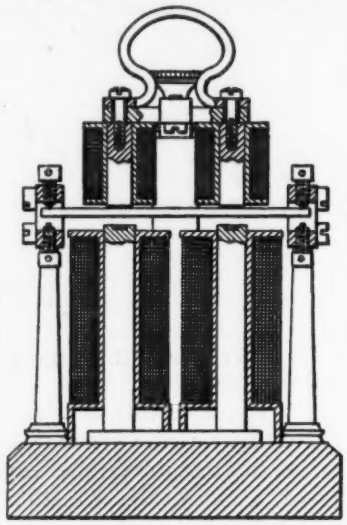
648,951. ELECTRIC SWITCH; A. Hanson, Chicago, Ill. App. filed May 31, 1899. Details of construction.

648,977. SIGNAL FOR SELECTIVE CALLING APPLIANCES; F. R. McBerty, Evanston, Ill. App. filed Sept. 14, 1898. In connection with plug circuits for making connection with party lines, an appliance for transmitting specialized calling currents for the different stations is used, and an indicator is arranged to be automatically operated to designate the particular call transmitted in connection with the plug circuit over which the call is sent.

648,978. SIGNALING APPARATUS FOR TELEPHONE LINES· F. R. McBerty, Chicago, Ill. App. filed June 7, 1899. In accordance with this invention a rotatable disk is associated with a group of calling keys connected with a given cord circuit at the central office switchboard, said disks carrying a number of targets corresponding to the selective signaling keys, the disk being adapted to display a target whenever the key corresponding to such target is actuated, the target remaining displayed until another one of the group of keys is operated, whereupon such target will be concealed and another one corresponding to the key last operated will be displayed.



649,031.—Electromagnet.



649,102.—Telegraphic Receiving Instrument.

648,995. ELECTRIC TRAIN SYSTEM; William B. Potter, Schenectady, N. Y. App. filed March 31, 1898. This invention aims to provide a device whereby when for any reason it becomes necessary the circuit may be instantaneously interrupted in all of the cars of a train by means controlled from a single point.

649,003. ENVELOP FOR STORAGE BATTERIES; E. A. Sperry, Cleveland, Ohio. (App. filed Oct. 7, 1899. (See Current News and Notes.)

649,006. ALTERNATING-CURRENT MOTIVE APPARATUS; C. P. Steinmetz, Schenectady, N. Y. App. filed Aug. 16, 1897. (See Current News and Notes.)

649,007. FREQUENCY INDICATOR; C. P. Steinmetz, Schenectady, N. Y. App. filed Jan. 9, 1899. (See Current News and Notes.)

649,008. FREQUENCY INDICATOR; C. P. Steinmetz, Schenectady, N. Y. App. filed Dec. 9, 1899. (See Current News and Notes.)

649,015. CURRENT INTERRUPTER; E. Thomson and R. Shand, Lynn, Mass. App. filed March 8, 1900. (See Current News and Notes.)

649,031. ELECTRO-MAGNET; S. M. Young, New York, N. Y. App. filed Jan. 7, 1892. The armature of the magnet is hung in the middle on a pivot parallel to the poles, each end of the armature carries two horns, one of which is longer than the other, and adapted to be brought under the influence of the pole-piece successively to give a uniform and extended motion of the armature.

649,068. SPRING JACK FOR TELEPHONE SWITCHBOARDS; Frank B. McBerty, Chicago, Ill. App. filed Jan. 26, 1898. The jack consists of a base plate of sheet metal, a thick strip of suitable material secured on one edge thereof carrying the thimbles or test rings of the jacks, the springs constituting the spring contacts of the jack mounted transversely on the other edge thereof by means of continuous strips of insulating material extending the length of the strip of spring jacks, and bolts clamping the springs between these strips.

649,069. SUPERVISORY SIGNAL FOR TELEPHONE LINES; F. R. McBerty, Evanston, Ill. App. filed June 17, 1899. (See next patent.)

649,075. SUPERVISORY SIGNAL FOR TELEPHONE SWITCHBOARDS; C. E. Scribner, Chicago, Ill. App. filed April 23, 1898. This invention, as well as the preceding, concerns the automatic operation of supervisory signals in association with devices for uniting lines of different character, comprising metallic and grounded circuit lines and metallic lines with permanent ground branches, the object of the invention being to attain a uniform operation of the signals independent of the character of the lines with which they are associated.

649,077. STATION APPLIANCE FOR TELEPHONE TOLL LINES; Clarence E. Scribner, Chicago, Ill. App. filed May 21, 1898. Consists of a switch and circuit connections therewith for severing the through line passing a station to permit the use simultaneously of different portions of the line between different stations, with means for ascertaining when the line is in use and for automatically restoring the continuity of the line at any station when its use at the same station is finished.

649,078. SIGNAL FOR TELEPHONE TRUNK LINES; Charles E. Scribner, Chicago, Ill. App. filed May 21, 1898. The invention concerns interoffice trunk lines of telephone-exchange systems, and it consists in a scheme of signals for the incoming terminals of such trunk lines to attain increased efficiency and reliability in the various operations involved in making connection between subscribers' lines by means of interoffice trunk lines.

649,085. ELECTROMAGNETIC COIL; R. Varley, Jersey City, N. J. App. filed Jan. 2, 1900. This is a coil composed of a series of coil sections arranged end to end with intervening air spaces, and a core consisting of a tube of insulating material softened by paraffin, and forced into close contact with the surface of the inner layer of the coil in order to anchor it in place.

649,102. TELEGRAPHIC RECEIVING INSTRUMENT; N. Flechtenmacher, Bucharest, Roumania. App. filed Aug. 3, 1898. A relay armature consisting of a perfectly free iron bar placed between the poles of two magnets.

649,105. APPARATUS FOR ELECTRIC LIGHTING; O. P. Loomis, of Depew, N. Y. App. filed Feb. 15, 1899. This is a switch used in connection with a generator, two storage batteries and lights, and adapted to connect both batteries in parallel with the lights when the generator is cut out and to connect the batteries in parallel with the charging circuit when the lights are cut out.

649,138. ELECTRO-MECHANICAL TYPEWRITING SYSTEM OF INTERCOMMUNICATION; A. D. Neal and H. F. Eaton, Boston, Mass. App. filed Aug. 15, 1899. This invention consists of general improvements in the machine and the circuits, an important object being to provide a system in which typewriting communication between different points or stations may be carried on with a minimum number of line wires.

649,151. APPARATUS FOR EXTRACTING METAL FROM REFRACTORY ORES; W. Wright, New York, N. Y. App. filed April 26, 1899. Dctails of the construction and arrangement of a tank and the electrodes therein.

649,179. TRANSFORMER SECONDARY; A. F. Rietzel, Lynn, Mass. App. filed Sept. 23, 1899. A transformer secondary consisting of two or more turns or partial turns of cast metal spaced apart to provide a depository for the primary of the transformer and a bar composed of metal strips secured to the ends of said partial turns and serving therewith to complete the secondary and to provide movable supports for work holders.

649,182. APPARATUS FOR PRODUCING RADIATION AND LIGHT BY ELECTRICITY; C. H. Stearn and C. F. Topham, London, England. App. filed Jan. 20, 1899. (See Current News and Notes.)

649,199. ELECTRIC SWITCH; W. Ely, Providence, R. I. App. filed April 28, 1898. Details of construction.

649,235. TROLLEY WHEEL; J. A. Collins, Cincinnati, Ohio. App. filed April 3, 1899. This is a ball-bearing wheel, in which the balls run in grooves formed around the body of the axle.

649,250. MARINE ELECTRIC LIGHT FIXTURE; G. L. Martin, New York, N. Y. App. filed Dec. 4, 1899. Details of construction affording primarily a water-tight device.

649,264. ELECTRIC BELL STRIKING APPARATUS; L. D. and E. D. Tillyer, Dover, N. J. App. filed Nov. 17, 1899. Details of construction relating to a tower-bell apparatus.

649,295. ACCUMULATOR; L. G. Garcia, Aspe, Spain. App. filed Dec. 11, 1897. (See Current News and Notes.)

649,308. INCANDESCENT LAMP SOCKET; H. Hubbell, Bridgeport, Conn. App. filed Oct. 9, 1899. The chain by which the switch is turned passes into the socket and around a pivoted switch arrangement which is rotated by pulling the chain.

649,349 and 649,350. GALVANIC BATTERY; C. M. Platt, Waterbury, Conn. App. filed July 29, 1899. (See Current News and Notes.)

649,371. GROUND PLUG FOR ELECTRICAL SWITCHBOARDS; W. I. Stockdon, Orange, Va. App. filed Feb. 16, 1900. This plug is fitted with the terminals of an independent alarm circuit for the purpose of notifying the operator when through with the line that the plug is to be removed.

649,388. LIGHTNING ARRESTER; A. J. Wurts, Pittsburg, Pa. App. filed June 8, 1899. (See Current News and Notes.)

649,390. BATTERY CONNECTION; G. F. Atwood, Chazy, N. Y. App. filed June 7, 1899. This is a clamp formed in two parts and bent at right-angles, with a screw passing through both of them at the bend.

649,398. PRIMARY ELECTRIC BATTERY; V. J. Busson, Paris, France. App. filed Nov. 18, 1898. (See Current News and Notes.)